

Engineering Design File

Shielding and Exposure Calculations for V-Tank Waste Process Activities



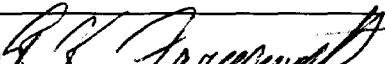
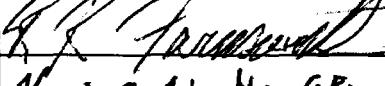
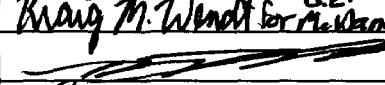
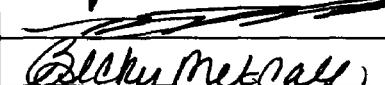
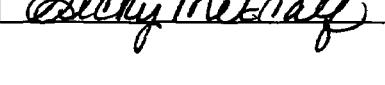
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5. Summary: The purpose of this Engineering Design File (EDF) is to document the shielding calculations that estimate exposure rates during processing and treatment of the V-Tank wastes. It was assumed that the maximum exposure rates would come from the sludge. The results are listed in Table 2. Separate exposure calculations were performed for each of the primary geometries: the consolidation tanks, piping, reaction vessel, the processing equipment, and area-shielding materials. In addition, scenarios were run for an individual standing on top of the V-3 and V-9 tanks with the current waste inventory in place. The V-Tank waste will be pumped into two high-integrity consolidation tanks where the waste will be treated and stored until final disposition.				
<p>MicroShield (MS 6) is a shielding code used to model exposures rates in air for the waste storage tanks, treatment equipment, transfer pipes, and concrete shielding. Exposure rates were calculated at contact, 1 ft, 2 ft, 3 ft, and 4 ft for the primary geometries. It was assumed that the worst-case scenario for exposure involved pumping the entire 1,880 gal of V-Tank sludge and the 80 gal of Auxiliary Reactor Area (ARA)-729 waste into one consolidation tank with a minimum dilution resulting in a 2,940 gal solution. However, only the radionuclide curie content and not the volume of the ARA waste was added to the consolidation tank inventory. Also, it was assumed for every other process exposure scenario that the 2,940 gal solution at the full radionuclide inventory would completely fill the volumes of pipes, pumps, reaction vessel, and system processing equipment. This allowed for determining the maximum exposure rate for the different geometries associated with treatment activities.</p> <p>The revision to this EDF incorporates the ARA waste stream that was added to the source term inventory since the initial issuance of this document.</p>				
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ACRONYMS

ARA	Auxiliary Reactor Area
DOE	Department of Energy
DOE-ID	Department of Energy Idaho Operations Office
EDF	Engineered Design File
EPA	Environmental Protection Agency
INEEL	Idaho National Engineering and Environmental Laboratory
MCP	Management Change Process
MS6	MicroShield 6.02
RPP	Radiation Protection Program
TAN	Test Area North

Shielding and Exposure Calculations for V-Tank Waste Process Activities

1. INTRODUCTION

This EDF develops the dose consequence for an individual(s) performing V-Tank waste process activities at Test Area North (TAN). Personnel will be operating the waste process system at distance from the actual tanks, piping, pumps, and process treatment equipment. The activities addressed here will not affect the public or the environment; therefore, the only consequences discussed are those to the process operators and co-located workers.

2. METHOD

In this analysis, the methodology used to calculate the exposure to a receptor is accomplished by utilizing shielding software. MicroShield 6.02¹ (MS6) was used to model the exposure rate resulting from direct gamma radiation exposure to an individual. Since there is no anticipated scenario for ingestion or inhalation of V-Tank sludge or liquefied waste, internal exposure is not considered.

Verification and Validation of MS 6:

The MS6 program is a radiological safety analysis and radiological engineering program that has been used extensively at the Idaho National Engineering and Environmental Laboratory (INEEL). MS6 has been independently verified and validated for these types of calculations. The MS6 program and computer information are:

Program Name: MS6
Version Number: 6.02 (6.02-00061)
Operating System: Microsoft Windows XP, Service Pack 1
Software Configuration and Control Number: 121983
Computer Type: DELL Precision 420 Workstation
CPU Number: 369306.

Microsoft Excel software was used to manipulate and calculate all tabular data representations within this EDF. The calculations performed with Excel can be reproduced and checked by hand. Excel is exempt from qualification per Management Control Procedure (MCP)-550, Section 4.2. The Excel program and computer information are:

Program Name: Excel
Version Number: Microsoft Excel 2000 (9.0.4402 SR-1)
Operating System: Microsoft Windows XP, Service Pack 1
Software Configuration and Control Number: N/A
Computer Type: DELL Precision 420 Workstation
CPU Number: 369306.

3. ASSUMPTIONS

The radionuclide inventory (source term) was taken from the combined V-Tank inventories and the Auxiliary Reactor Area (ARA)-729 waste stream. The actual activity values for the V-Tanks were taken from EDF-3868, "V-Tank Analytical Data: Calculated Averages and Upper Confidence Limits."² The

activity values used for the ARA waste stream were taken from EDF-4928, "Potential Feed Streams for Inclusion into V-Tank Treatment Process."³ The values are listed in Table 1, "V-Tank and ARA Source Terms." The sludge volume was obtained from the conceptual design report for "Ex Situ Chemical Oxidation/Reduction and Stabilization of the V-Tanks at Waste Area Group 1, Operable Unit 1-10."⁴ The volume was listed in Table 1 of that report. V-Tank capacities and current contents (in gallons) were listed as 1,880 gal total. The sludge density for each tank inventory was taken from EDF-3868. The sludge densities from each tank were then averaged together for an overall density of 1.02 g/cm³. The source material utilized a custom material file "V123 sludge" (V123.MT5) obtained from the radiological engineering staff.

Combining the activity to the total volume of the sludge derived the source term. Later in the process the ARA source term was added to the V-Tank inventory; however, only the radioactivity was added to the tanks. This produced marginally more conservative exposures for the different scenarios. The ARA waste was comprised of approximately 80 gal of waste with a calculated density of 1.18 g/cm³ and was considered an insignificant amount (2.7 %) of the total process volume. To change or alter the custom material file "V123 sludge" would have required considerable effort for marginal changes in the exposure rates for the various scenarios. The difference between the calculated sludge densities of the two waste streams was 0.16 g/cm³.

The source term geometries were divided into two categories: cylinders and a rectangle. The cylinder geometry included the consolidation tanks, pipes, the reaction vessel, and the V-9 tank with the V-3 tank being the only rectangular geometry (to simulate a horizontal cylinder geometry). The key assumptions associated with the V-3 scenario were that the tank was 18 feet long with a diameter of 10 feet, with the sludge thickness being approximately 0.5 feet and the resulting air gap being the remaining 9.5 feet.

It was assumed that the worst-case scenario for exposure was to have the entire V-tank and ARA radionuclide sludge inventories (1,880 gal) pumped into one of the consolidation tanks, essentially creating a double batch. However, more realistic scenarios were created on the assumption that exposure values should be closer to actual operational conditions. The volume of the source term in the consolidation tank was increased to 2,940 gal. The assumed minimum amount of supernate required to transfer the sludge from the V-Tanks into a single consolidation tank was 1,060 gal. The 1,060 gal plus the 1,880 gal of sludge makes up the 2,940 gal total. It was this calculated value that the different scenarios for exposure were based upon.

The different geometry calculations for the pipes, pumps, and reaction vessel were performed internally by MS6. A consolidation tank containing the entire radionuclide inventory was used as the base scenario. By changing the physical dimensions of the geometry and keeping the activity concentrations constant, MS6 calculated the exposure based on the new geometry. The amount of radionuclide inventory for the pipes, pumps, and reaction vessel were calculated by dividing the specific geometric volume by the 2,940-gal tank volume, then multiplying the result by the individual radionuclide activities of the 2,940-gal volume, and then summing the results to obtain a geometry total activity. The long hand pipe geometry activity example calculation is shown below.

$$\Sigma[(V_p/V_t) \times A_{\text{tank}}] = A_{\text{total}}$$

Where:

V_p = pipe volume

V_t = tank volume

A_{tank} = activity per nuclide in tank

A_{total} = total activity of all nuclides summed.

The V-Tank sampling occurred approximately eight years ago and approximately six years have passed since the ARA samples were analyzed. The V-Tank and ARA activity amounts were decayed in MS6 for eight and six years respectively in order to provide a more realistic source term for the shielding calculations.

Table 1. V-Tank and ARA source terms.

Nuclide	Tank 1 Sludge (Ci)	Tank 2 Sludge (Ci)	Tank 3 Sludge (Ci)	Tank 9 Sludge (Ci)	Total V-Tank Activity (Ci)	ARA Activity (Ci)	Total V-Tank & ARA Activity (Ci)
Ag-108m	1.40E-03	1.43E-03	2.07E-03	0.00E+00	4.90E-03	6.63E-04	5.56E-03
Ag-110m	2.46E-03	2.42E-03	3.70E-03	0.00E+00	8.58E-03	7.05E-05	8.65E-03
Am-241	2.71E-02	3.52E-03	1.56E-02	5.33E-03	5.15E-02	4.41E-03	5.59E-02
Ce-144	1.63E-02	1.35E-02	2.94E-02	0.00E+00	5.92E-02	3.71E-04	5.95E-02
Cm-242	9.46E-05	6.21E-06	1.05E-04	0.00E+00	2.05E-04	2.40E-07	2.06E-04
Cm-243	7.98E-03	2.29E-04	4.38E-03	6.16E-04	1.32E-02	1.92E-06	1.32E-02
Cm-244	7.98E-03	2.29E-04	4.38E-03	6.16E-04	1.32E-02	1.96E-06	1.32E-02
Co-58	2.86E-03	2.20E-03	3.67E-03	0.00E+00	8.73E-03	5.04E-05	8.78E-03
Co-60	3.07E-01	3.81E-01	4.08E-01	1.00E+00	2.10E+00	2.77E-02	2.13E+00
Cs-134	1.97E-03	7.78E-04	3.30E-03	0.00E+00	6.04E-03	4.26E-03	1.03E-02
Cs-137	1.11E+01	1.10E+01	1.65E+01	5.95E+00	4.46E+01	1.70E+00	4.63E+01
Eu-152	4.46E-02	2.29E-02	3.98E-02	0.00E+00	1.07E-01	3.01E-03	1.10E-01
Eu-154	6.00E-02	3.28E-02	6.84E-02	2.36E-02	1.85E-01	8.24E-04	1.86E-01
Eu-155	5.56E-03	5.67E-03	9.37E-03	0.00E+00	2.06E-02	1.33E-04	2.07E-02
Fe-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.67E-08	7.67E-08
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.33E-03	9.33E-03
I-129	8.57E-05	9.80E-05	1.53E-04	0.00E+00	3.37E-04	6.57E-06	3.43E-04
Mn-54	1.02E-03	8.25E-04	1.30E-03	0.00E+00	3.15E-03	1.88E-05	3.17E-03
Nb-95	6.30E-03	2.32E-03	6.95E-03	0.00E+00	1.56E-02	5.58E-05	1.56E-02
Ni-63	2.12E+00	1.31E+00	2.08E+00	0.00E+00	5.51E+00	9.58E-03	5.52E+00
Np-237	3.37E-05	3.71E-05	6.46E-05	3.20E-05	1.67E-04	1.35E-06	1.69E-04
Pu-238	2.41E-02	1.12E-02	2.91E-02	2.14E-02	8.57E-02	3.08E-03	8.88E-02
Pu-239	1.10E-02	9.45E-03	1.50E-02	7.75E-03	4.32E-02	3.11E-03	4.63E-02
Pu-240	1.10E-02	9.45E-03	1.50E-02	7.75E-03	4.32E-02	1.43E-05	4.32E-02
Ra-226	7.63E-04	3.48E-03	6.35E-03	0.00E+00	1.06E-02	4.58E-05	1.06E-02

Table 1. (continued).

Nuclide	Tank 1 Sludge (Ci)	Tank 2 Sludge (Ci)	Tank 3 Sludge (Ci)	Tank 9 Sludge (Ci)	Total V-Tank Activity (Ci)	ARA Activity (Ci)	Total V-Tank & ARA Activity (Ci)
Ru-103	2.36E-02	1.71E-02	3.55E-02	0.00E+00	7.61E-02	4.91E-04	7.66E-02
Ru-106	1.91E-02	1.60E-02	2.90E-02	0.00E+00	6.41E-02	4.52E-04	6.45E-02
Sb-125	7.71E-03	6.27E-03	1.17E-02	0.00E+00	2.57E-02	1.91E-04	2.58E-02
Sr-90	9.74E+00	1.94E+01	4.71E+01	6.82E+00	8.31E+01	5.30E-01	8.36E+01
Th-228	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-08	1.22E-08
Th-230	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-08	1.31E-08
U-233	6.64E-03	4.59E-03	4.86E-03	1.14E-02	2.75E-02	6.98E-04	2.82E-02
U-234	6.64E-03	4.59E-03	4.86E-03	1.14E-02	2.75E-02	5.46E-03	3.30E-02
U-235	2.01E-04	1.40E-04	1.59E-04	3.75E-04	8.76E-04	2.30E-05	8.99E-04
U-238	1.09E-04	1.26E-04	1.49E-04	8.55E-05	4.69E-04	6.97E-05	5.39E-04
Zn-65	2.57E-03	2.10E-03	3.24E-03	0.00E+00	7.91E-03	7.82E-04	8.70E-03
Zr-95	5.56E-03	4.15E-03	8.02E-03	0.00E+00	1.77E-02	9.87E-05	1.78E-02

3.1 Volume Calculations

The consolidation tank volume was calculated using the standard cylinder volume formula. The tanks are ellipsoidal at the bottom. To account for this in MS6, the volume of the tank dome section was added to the volume of the cylinder. The formula for calculating the elliptical volume was obtained from http://www.monolithic.com/plan_design/calcs/. The total volume for the tank sludge content was 251.3 ft³ (7.12E6 cm³). The equation below was solved for ‘H’ to determine the correct geometry for MS6 for the 1,880 gal volume. The value for ‘H’ was approximately 3.20 ft (97.5 cm). The ‘H’ value calculated for the 2,940 gal volume was derived using the same formula. The addition of 1,060 gal of supernate changed the value of ‘H’ to 5 ft (152.4 cm).

$$V = \pi \times R^2 \times H$$

Where:

V = volume

R = tank radius 5 ft (152.4 cm)

H = height of sludge in the tank 3.20 ft (97.5 cm) 1,880 gal scenario.

H = height of sludge in the tank 5.0 ft (152.4 cm) 2,940 gal scenario.

The pipe volume was calculated using the standard cylinder volume formula. A pipe length of 10 ft was chosen to give a representative exposure under operational conditions. The volume was considered a process sludge-filled solid geometry with no void space internally. The 10-ft length was used to demonstrate that the exposure was uniform along the axis of the pipe due to quadrature calculations in MS 6. The volume of the pipe was 0.22 ft³ (6,230 cm³).

$$V = \pi \times R^2 \times L$$

Where:

V = Volume

R = pipe radius I.D.

1 in. (2.54 cm)

L = length of pipe

10 ft (304.8 cm).

The reaction vessel is essentially a vertical cylinder. The volume was considered a partially sludge-filled solid geometry with void space internally. The volume was 400 gal (1.51E6 cm³) utilizing the typical cylinder formula. However, it was assumed that only 63 gal of process sludge would be added to the reaction vessel per batch. The remaining 337 gal would be comprised of process aggregate. The concentration values were derived in MS6 by utilizing the 2,940 gal half radionuclide inventory base case. The volume geometry was reduced to 63 gal thereby reducing the radionuclide inventory concentration. To complete the concentration calculation, the 337 gal of aggregate was added to the 63 gal geometry. The activity concentrations were held constant on a curie per volume basis in order to obtain the correct radionuclide concentration for the reaction vessel skid.

$$V = \pi \times R^2 \times H$$

Where:

V = Volume

R = radius of reactor vessel I.D. 27.6 in. (70.10 cm)

H = height of waste in the tank 38.61 in. (98.07 cm).

The V-9 tank is a vertical cylinder with a pointed cone bottom. The volume was considered a sludge-filled solid geometry with a 2.55 ft internal air gap between the sludge and the top of the tank. The cone volume at the bottom of the tank was added to the cylindrical volume of the tank to facilitate the MS6 standard cylinder geometry. The volume is 320 gal (1.21E6 cm³) utilizing the typical cylinder formula.

$$V = \pi \times R^2 \times H$$

Where:

V = Volume

R = radius of V-9 tank I.D. 21.0 in. (53.3 cm)

H = height of sludge in the tank 53.3 in. (135.33 cm)

The V-3 tank scenario is a rectangular box. This geometry was used to model the horizontal cylindrical tank configuration given that MS6 does not have this capability. The base scenario assumes a 9.02 ft internal air gap between the sludge and the top of the tank. The volume is 652 gal (2.47E6 cm³) utilizing the typical rectangle formula.

$$V = L \times W \times H$$

Where:

V = Volume

L = length of the tank

18 ft (548.64 cm)

W = width of the tank

10 ft (304.8 cm)

H = height of sludge in the tank

5.81 in. (14.75 cm).

3.2 Shielding Materials

The assumed construction materials for the consolidation tanks and the reaction vessel were Type 304L stainless steel and iron respectively. The MS6 default density value for iron was used for the reaction vessel. The piping material was assumed to be Schedule 40 304L stainless steel. A custom material file was created for determining the density of the material. Values for the makeup of Type 304L stainless steel were obtained from www.Matweb.com.⁶ The shielding surrounding the consolidation tanks is preformed concrete slabs. The slabs are 14 inches thick at the bottom tapering to 12 inches thick at the top. Standard concrete blocks were used for modeling the shielding for the reaction vessel skid. Both of the concrete shielding scenarios used the MS6 default density value for concrete. The concrete block dimensions were $2 \times 2 \times 6$ ft and stacked 8 ft high. The pump maintenance shield was assumed to be approximately 1.25 in. (3.175 cm) thick and made of standard carbon steel. The MS6 default density value of iron (7.86 g/cm^3) was used for the shield material.

3.3 Exposure Scenarios

There were 16 different exposure scenarios (listed in Table 2). Exposure summaries along with the approximate exposure rates are listed for the different dose receptor points. The values in Table 2 have been rounded up for ease of reference. The actual values are located in Appendix A.

A shielding sensitivity analysis was performed on different materials for the pump maintenance shield to reduce the exposure rate to individuals performing maintenance or other activities in the consolidation tank pump area. A gap of six inches between the tank walls and the pump shielding material was assumed for each of the material sensitivity analyses. The base scenario used was the 1880-gal geometry consisting of pure sludge in one tank. Different shielding materials were placed next to the consolidation tanks and the exposure rates were calculated with MS6 for increasing thicknesses of material. The shielding materials analyzed were tungsten, lead, iron, aluminum, and concrete. The exposure rate results shown in Table 2 for the pump maintenance shield were from the iron sensitivity analysis. The approximate amount of iron required to reduce the exposure rate from 1,087 mR/hr to 115 mR/hr was 1.25 in (3.175 cm).

Table 2. Exposure summaries.

Geometry	Contact (mR/h)	One foot (mR/h)	Two feet (mR/h)	Three feet (mR/h)	Four feet (mR/h)
Side of Consolidation Tank @ 1,880 gal	1,670	978	583	386	274
Side of Consolidation Tank @ 2,940 gal	1,087	747	500	350	257
Side of Consolidation Tank @ 2,940 gal with 14" concrete wall for shielding	2	1.8	N/A	1.3	N/A
Top of Consolidation Tank @ 2,940 gal with internal air gap	156	135	117	102	90
Top of Consolidation Tank @ 2,940 gal with 1/2" of Pb shielding	62	54	47	42	37
Side of Consolidation Tank @ 2,940 gal 1.25" Fe pump maintenance shield	115	96	74	57	N/A
2" Stainless Steel Pipes based on Consolidation Tank @ 2,940 gal conc.	82	13	6	4	2.6
2 gal Pump based on Consolidation Tank @ 2,940 gal conc.	181	21	8	4	2.5

Table 2. (continued).

Geometry	Contact (mR/h)	One foot (mR/h)	Two feet (mR/h)	Three feet (mR/h)	Four feet (mR/h)
2 gal Pump 3/8" of Pb shielding based on Consolidation Tank @ 2,940 gal conc.	25	3	1	0.6	0.4
Top of V-3 Tank @ 652 gal 2 ft homogeneous mixture no shield	146	128	111	97	86
Top of V-3 Tank @ 652 gal 2 ft homogeneous mixture 1.25" Fe shield	26	24	21	19	17
Top of V-9 Tank @ 320 gal with internal air gap no shield	310	200	135	96	72
Top of V-9 Tank @ 320 gal with internal air gap and 1.25" Fe shield	107	71	49	35	27
Reaction Vessel side no shield based on Consolidation Tank @ 2,940 gal conc.	96	46	25	15	10
Reaction Vessel top no shield based on Consolidation Tank @ 2,940 gal conc.	47	29	19	13	9
Reaction Vessel side 3/8" Fe shield with 16" air gap based on Consolidation Tank @ 2,940 gal conc.	25	15	N/A	7	N/A

In all of the scenarios and geometries except the consolidation tanks pump shield, the 2" stainless steel piping, the lead shielding over the circulation pumps, the concrete wall surrounding the consolidation tanks, and the V-3 tank with the iron shield, the buildup was calculated in the source. Buildup for the V-3 tank, however, was calculated in the iron shield at an energy of 0.6 MeV. This region was chosen based upon its proximity to the dose response point and the scattering cross-section dominance of the iron shield. This was the same case for the lead shielding surrounding the pump housings. Buildup for the iron pump shield and the 2" stainless steel piping was calculated in the metal shields also at an energy of 0.6 MeV. In these two scenarios the number of mean free paths dominated in the shields rather than the sludge. In the case of the 2" stainless steel pipe, the pipe wall was relatively thick in comparison to the thickness of the source material. The iron pump shield scenario and the concrete shield wall were similar to the pipe scenario; however, the six-inch air gap and consolidation tank wall caused additional scattering which increased the buildup in these shielding materials. The 0.6 MeV photon energy dominated the gamma ray spectrum due to the large proportion of Cs-137 in the sludge.

The buildup for the remaining scenarios, due to Compton scattering of primary photons between 0.1 and 5 Mev, was calculated in the source at an energy of 0.6 MeV for all cases. This region was chosen based upon the number of mean free paths, the thin shield material in comparison to the source material, and the scattering cross-section dominance of the sludge. This model proved to satisfy all geometric parameter constraints associated with the MS6 point kernel mathematical models and is insensitive to changes in x, y, and z coordinate quadrature. The quadrature inputs were 21, 21, 21 for the x, y, and z coordinates, respectively.

4. CONCLUSIONS

The analysis shows that the exposure to the process operators and co-located workers does not challenge the Department of Energy, Idaho Operations Office (DOE-ID) Guide 420.D requirements.⁷ Risk to process operators and co-located workers does not increase or exceed safety requirements. If additional material or activities need to be added to the processing activities, further analysis will be required.

This exposure consequence analysis concludes that these new activities can be conducted safely, and that the equipment and controls implemented by the INEEL Radiation Protection Program (RPP) are adequate to minimize radiation exposure to the process operators and co-located workers. There is no potential radiation exposure to the public or the environment.

5. REFERENCES

1. MicroShield, Version 6.02, Rockville, MD, Grove Engineering, 2003.
2. EDF-3868, "V-Tank Analytical Data: Calculated Averages and Upper Confidence Limits," Rev. 1, D. R. Tyson, December 8, 2003.
3. EDF-4928, "Potential Feed Streams for Inclusion into V-Tank Treatment Process," Rev. 0, D. R. Tyson, September 9, 2004.
4. Conceptual Design Report, "Ex Situ Chemical Oxidation/Reduction and Stabilization of the V-Tanks at Waste Area Group 1, Operable Unit 1-10," INEEL/EXT-03-00438, Project # 22901, June 2003.
5. http://www.monolithic.com/plan_design/calcs/.
6. <http://www.matweb.com/index.asp?ckck=1>.
7. DOE-ID Guide 420.D, Rev. 1, "Non-Reactor Nuclear Facility Safety Analysis Guide," U.S. Department of Energy, Idaho Operations Office, September 16, 2004.

431.02
01/30/2003
Rev. 11

ENGINEERING DESIGN FILE

Appendix A
MicroShield v6.02

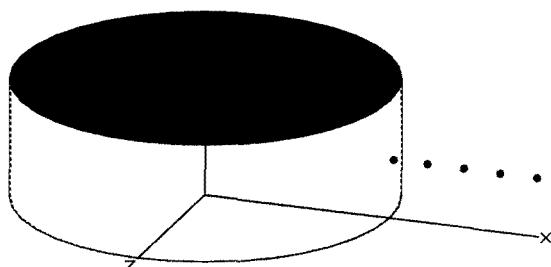
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK Consolidation tank 1880 gal decayed 8yr & 6yr plus A
 Run Date: December 2, 2004
 Run Time: 9:07:24 AM
 Duration : 00:00:32

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: TAN V tank Process
Description: V-tank + ARA waste Decayed 8yrs & 6yrs 1880 gal (1880 gal)
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions

Height	97.5 cm	3 ft 2.4 in
Radius	152.4 cm	5 ft 0.0 in

Dose Points

#	X	Y	Z
# 1	155.89 cm 5 ft 1.4 in	48.8 cm 1 ft 7.2 in	0 cm 0.0 in
# 2	183.8325 cm 6 ft 0.4 in	48.8 cm 1 ft 7.2 in	0 cm 0.0 in
# 3	214.3125 cm 7 ft 0.4 in	48.8 cm 1 ft 7.2 in	0 cm 0.0 in
# 4	244.7925 cm 8 ft 0.4 in	48.768 cm 1 ft 7.2 in	0 cm 0.0 in
# 5	275.2725 cm 9 ft 0.4 in	48.768 cm 1 ft 7.2 in	0 cm 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	4.34e+05 in ³	V123 SLUDGE	1.02
Shield 1	.375 in	304L	8
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	2.0900e-005	7.7330e+005	2.9378e-006	1.0870e-001
Ac-227	1.7700e-008	6.5490e+002	2.4880e-009	9.2056e-005
Ac-228	5.1800e-019	1.9166e-008	7.2812e-020	2.6941e-015
Ag-108	4.9600e-004	1.8352e+007	6.9720e-005	2.5796e+000
Ag-108m	5.3300e-003	1.9721e+008	7.4921e-004	2.7721e+001
Ag-110	3.5500e-008	1.3135e+003	4.9900e-009	1.8463e-004
Ag-110m	2.6700e-006	9.8790e+004	3.7531e-007	1.3886e-002
Am-241	5.5200e-002	2.0424e+009	7.7592e-003	2.8709e+002
Am-243	2.1600e-008	7.9920e+002	3.0362e-009	1.1234e-004
At-217	2.0900e-005	7.7330e+005	2.9378e-006	1.0870e-001
Ba-137m	3.6500e+001	1.3505e+012	5.1306e+000	1.8983e+005
Bi-210	2.3300e-003	8.6210e+007	3.2752e-004	1.2118e+001
Bi-211	1.7200e-008	6.3640e+002	2.4177e-009	8.9455e-005
Bi-212	1.0800e-009	3.9960e+001	1.5181e-010	5.6170e-006
Bi-213	2.0900e-005	7.7330e+005	2.9378e-006	1.0870e-001
Bi-214	1.0600e-002	3.9220e+008	1.4900e-003	5.5129e+001
Ce-144	4.8600e-005	1.7982e+006	6.8314e-006	2.5276e-001
Cm-242	8.4300e-010	3.1191e+001	1.1850e-010	4.3843e-006
Cm-243	1.0900e-002	4.0330e+008	1.5322e-003	5.6690e+001
Cm-244	9.7200e-003	3.5964e+008	1.3663e-003	5.0553e+001
Co-58	5.2800e-015	1.9536e-004	7.4218e-016	2.7461e-011
Co-60	7.4500e-001	2.7565e+010	1.0472e-001	3.8747e+003
Cs-134	8.5800e-004	3.1746e+007	1.2060e-004	4.4624e+000

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK Consolidation tank 1880 gal decayed 8yr & 6yr plus A
Run Date: December 2, 2004
Run Time: 9:07:24 AM
Duration : 00:00:32

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Cs-137	3.8600e+001	1.4282e+012	5.4258e+000	2.0075e+005
Eu-152	7.3300e-002	2.7121e+009	1.0303e-002	3.8122e+002
Eu-154	9.9000e-002	3.6630e+009	1.3916e-002	5.1489e+002
Eu-155	6.7900e-003	2.5123e+008	9.5443e-004	3.5314e+001
Fe-55	1.3700e-008	5.0690e+002	1.9257e-009	7.1252e-005
Fr-221	2.0900e-005	7.7330e+005	2.9378e-006	1.0870e-001
Fr-223	2.4400e-010	9.0280e+000	3.4298e-011	1.2690e-006
Gd-152	1.2600e-015	4.6620e-005	1.7711e-016	6.5531e-012
H-3	6.3900e-003	2.3643e+008	8.9821e-004	3.3234e+001
I-129	3.4400e-004	1.2728e+007	4.8354e-005	1.7891e+000
Mn-54	4.9300e-006	1.8241e+005	6.9298e-007	2.5640e-002
Nb-95	6.1000e-015	2.2570e-004	8.5744e-016	3.1725e-011
Nb-95m	2.3400e-017	8.6580e-007	3.2892e-018	1.2170e-013
Ni-63	5.2200e+000	1.9314e+011	7.3375e-001	2.7149e+004
Np-237	1.6800e-004	6.2160e+006	2.3615e-005	8.7375e-001
Np-239	2.1600e-008	7.9920e+002	3.0362e-009	1.1234e-004
Pa-231	1.5100e-007	5.5870e+003	2.1225e-008	7.8533e-004
Pa-233	1.6800e-004	6.2160e+006	2.3615e-005	8.7375e-001
Pa-234	8.6200e-007	3.1894e+004	1.2117e-007	4.4832e-003
Pa-234m	5.3900e-004	1.9943e+007	7.5764e-005	2.8033e+000
Pb-209	2.0900e-005	7.7330e+005	2.9378e-006	1.0870e-001
Pb-210	2.3400e-003	8.6580e+007	3.2892e-004	1.2170e+001
Pb-211	1.7200e-008	6.3640e+002	2.4177e-009	8.9455e-005
Pb-212	1.0800e-009	3.9960e+001	1.5181e-010	5.6170e-006
Pb-214	1.0600e-002	3.9220e+008	1.4900e-003	5.5129e+001
Po-210	2.1900e-003	8.1030e+007	3.0784e-004	1.1390e+001
Po-211	4.6900e-011	1.7353e+000	6.5925e-012	2.4392e-007
Po-212	6.9400e-010	2.5678e+001	9.7552e-011	3.6094e-006
Po-213	2.0500e-005	7.5850e+005	2.8816e-006	1.0662e-001
Po-214	1.0600e-002	3.9220e+008	1.4900e-003	5.5129e+001
Po-215	1.7200e-008	6.3640e+002	2.4177e-009	8.9455e-005
Po-216	1.0800e-009	3.9960e+001	1.5181e-010	5.6170e-006
Po-218	1.0600e-002	3.9220e+008	1.4900e-003	5.5129e+001
Pr-144	4.8600e-005	1.7982e+006	6.8314e-006	2.5276e-001
Pr-144m	6.9500e-007	2.5715e+004	9.7692e-008	3.6146e-003
Pu-238	8.3400e-002	3.0858e+009	1.1723e-002	4.3375e+002
Pu-239	4.6300e-002	1.7131e+009	6.5081e-003	2.4080e+002
Pu-240	4.3200e-002	1.5984e+009	6.0724e-003	2.2468e+002
Ra-223	1.7200e-008	6.3640e+002	2.4177e-009	8.9455e-005
Ra-224	1.0800e-009	3.9960e+001	1.5181e-010	5.6170e-006
Ra-225	2.1100e-005	7.8070e+005	2.9659e-006	1.0974e-001
Ra-226	1.0600e-002	3.9220e+008	1.4900e-003	5.5129e+001
Ra-228	5.1800e-019	1.9166e-008	7.2812e-020	2.6941e-015
Rh-103m	9.6800e-023	3.5816e-012	1.3607e-023	5.0345e-019
Rh-106	2.6600e-004	9.8420e+006	3.7390e-005	1.3834e+000
Rn-219	1.7200e-008	6.3640e+002	2.4177e-009	8.9455e-005
Rn-220	1.0800e-009	3.9960e+001	1.5181e-010	5.6170e-006
Rn-222	1.0600e-002	3.9220e+008	1.4900e-003	5.5129e+001
Ru-103	9.7000e-023	3.5890e-012	1.3635e-023	5.0449e-019
Ru-106	2.6600e-004	9.8420e+006	3.7390e-005	1.3834e+000
Sb-125	3.5100e-003	1.2987e+008	4.9338e-004	1.8255e+001
Sr-90	6.8900e+001	2.5493e+012	9.6849e+000	3.5834e+005
Te-125m	8.5900e-004	3.1783e+007	1.2074e-004	4.4676e+000
Th-227	1.7100e-008	6.3270e+002	2.4037e-009	8.8935e-005
Th-228	1.0800e-009	3.9960e+001	1.5181e-010	5.6170e-006
Th-229	2.1200e-005	7.8440e+005	2.9800e-006	1.1026e-001
Th-230	2.3200e-006	8.5840e+004	3.2611e-007	1.2066e-002
Th-231	8.9900e-004	3.3263e+007	1.2637e-004	4.6756e+000
Th-232	2.0200e-018	7.4740e-008	2.8394e-019	1.0506e-014
Th-234	5.3900e-004	1.9943e+007	7.5764e-005	2.8033e+000

ENGINEERING DESIGN FILE

Page : 3
DOS File : VTANK Consolidation tank 1880 gal decayed 8yr & 6yr plus A
Run Date: December 2, 2004
Run Time: 9:07:24 AM
Duration : 00:00:32

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bg/cm^3</u>
Tl-207	1.7100e-008	6.3270e+002	2.4037e-009	8.8935e-005
Tl-208	3.8900e-010	1.4393e+001	5.4680e-011	2.0231e-006
Tl-209	4.5200e-007	1.6724e+004	6.3535e-008	2.3508e-003
U-233	2.8200e-002	1.0434e+009	3.9639e-003	1.4666e+002
U-234	3.3000e-002	1.2210e+009	4.6386e-003	1.7163e+002
U-235	8.9900e-004	3.3263e+007	1.2637e-004	4.6756e+000
U-236	1.0200e-008	3.7740e+002	1.4338e-009	5.3049e-005
U-238	5.3900e-004	1.9943e+007	7.5764e-005	2.8033e+000
Y-90	6.8900e+001	2.5493e+012	9.6849e+000	3.5834e+005
Zn-65	2.7500e-006	1.0175e+005	3.8655e-007	1.4302e-002
Zr-95	2.7600e-015	1.0212e-004	3.8796e-016	1.4354e-011

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (6.14e+01,1.92e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
0.015	1.681e+10	1.563e-217	2.186e-23	1.341e-218	1.875e-24
0.02	1.296e+08	3.997e-99	3.693e-25	1.384e-100	1.279e-26
0.03	7.971e+10	1.976e-29	1.461e-21	1.958e-31	1.448e-23
0.04	2.118e+10	1.282e-12	4.773e-11	5.671e-15	2.111e-13
0.05	6.155e+08	1.200e-07	7.367e-06	3.197e-10	1.963e-08
0.06	7.438e+08	1.462e-04	9.509e-03	2.904e-07	1.889e-05
0.08	1.878e+08	1.306e-02	5.729e-01	2.067e-05	9.066e-04
0.1	2.512e+09	1.824e+00	5.204e+01	2.790e-03	7.961e-02
0.15	7.230e+06	4.676e-02	6.885e-01	7.700e-05	1.134e-03
0.2	5.821e+08	9.012e+00	9.473e+01	1.591e-02	1.672e-01
0.3	8.776e+08	3.376e+01	2.449e+02	6.403e-02	4.646e-01
0.4	5.651e+08	3.822e+01	2.218e+02	7.448e-02	4.322e-01
0.5	4.628e+07	4.772e+00	2.355e+01	9.367e-03	4.622e-02
0.6	1.216e+12	1.762e+05	7.672e+05	3.438e+02	1.498e+03
0.8	2.157e+09	5.325e+02	1.931e+03	1.013e+00	3.673e+00
1.0	2.998e+10	1.118e+04	3.567e+04	2.061e+01	6.574e+01
1.5	2.970e+10	2.328e+04	6.012e+04	3.916e+01	1.012e+02
2.0	1.050e+08	1.367e+02	3.130e+02	2.114e-01	4.840e-01
3.0	1.436e+01	3.695e-05	7.292e-05	5.013e-08	9.893e-08
TOTALS:	1.402e+12	2.114e+05	8.659e+05	4.050e+02	1.670e+03

Results - Dose Point # 2 - (72.375,1.92e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
0.015	1.681e+10	1.294e-188	1.186e-23	1.110e-189	1.017e-24
0.02	1.296e+08	5.892e-87	2.004e-25	2.041e-88	6.941e-27
0.03	7.971e+10	2.571e-26	7.927e-22	2.548e-28	7.856e-24
0.04	2.118e+10	1.148e-11	3.718e-10	5.076e-14	1.644e-12
0.05	6.155e+08	2.189e-07	1.160e-05	5.831e-10	3.091e-08
0.06	7.438e+08	1.551e-04	8.976e-03	3.081e-07	1.783e-05
0.08	1.878e+08	1.030e-02	4.290e-01	1.629e-05	6.789e-04
0.1	2.512e+09	1.348e+00	3.769e+01	2.063e-03	5.767e-02

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK Consolidation tank 1880 gal decayed 8yr & 6yr plus A
 Run Date: December 2, 2004
 Run Time: 9:07:24 AM
 Duration : 00:00:32

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.15	7.230e+06	3.311e-02	4.667e-01	5.453e-05	7.685e-04
0.2	5.821e+08	6.248e+00	6.118e+01	1.103e-02	1.080e-01
0.3	8.776e+08	2.282e+01	1.512e+02	4.328e-02	2.868e-01
0.4	5.651e+08	2.540e+01	1.339e+02	4.948e-02	2.609e-01
0.5	4.628e+07	3.126e+00	1.401e+01	6.136e-03	2.749e-02
0.6	1.216e+12	1.140e+05	4.513e+05	2.225e+02	8.808e+02
0.8	2.157e+09	3.375e+02	1.116e+03	6.419e-01	2.122e+00
1.0	2.998e+10	6.963e+03	2.035e+04	1.284e+01	3.751e+01
1.5	2.970e+10	1.402e+04	3.354e+04	2.358e+01	5.643e+01
2.0	1.050e+08	8.050e+01	1.723e+02	1.245e-01	2.665e-01
3.0	1.436e+01	2.119e-05	3.964e-05	2.875e-08	5.378e-08
TOTALS:	1.402e+12	1.355e+05	5.068e+05	2.598e+02	9.779e+02

Results - Dose Point # 3 - (84.375,1.92e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.681e+10	3.674e-188	7.609e-24	3.151e-189	6.526e-25
0.02	1.296e+08	6.403e-87	1.286e-25	2.218e-88	4.453e-27
0.03	7.971e+10	1.769e-26	5.086e-22	1.753e-28	5.040e-24
0.04	2.118e+10	9.273e-12	3.034e-10	4.101e-14	1.342e-12
0.05	6.155e+08	1.919e-07	1.015e-05	5.112e-10	2.703e-08
0.06	7.438e+08	1.299e-04	7.372e-03	2.580e-07	1.464e-05
0.08	1.878e+08	7.879e-03	3.156e-01	1.247e-05	4.994e-04
0.1	2.512e+09	9.685e-01	2.547e+01	1.482e-03	3.896e-02
0.15	7.230e+06	2.199e-02	2.904e-01	3.621e-05	4.782e-04
0.2	5.821e+08	4.033e+00	3.726e+01	7.118e-03	6.576e-02
0.3	8.776e+08	1.440e+01	9.090e+01	2.731e-02	1.724e-01
0.4	5.651e+08	1.585e+01	8.015e+01	3.088e-02	1.562e-01
0.5	4.628e+07	1.937e+00	8.364e+00	3.802e-03	1.642e-02
0.6	1.216e+12	7.026e+04	2.691e+05	1.371e+02	5.253e+02
0.8	2.157e+09	2.064e+02	6.644e+02	3.925e-01	1.264e+00
1.0	2.998e+10	4.236e+03	1.211e+04	7.808e+00	2.233e+01
1.5	2.970e+10	8.459e+03	1.997e+04	1.423e+01	3.359e+01
2.0	1.050e+08	4.841e+01	1.027e+02	7.486e-02	1.588e-01
3.0	1.436e+01	1.272e-05	2.369e-05	1.726e-08	3.214e-08
TOTALS:	1.402e+12	8.325e+04	3.022e+05	1.597e+02	5.831e+02

Results - Dose Point # 4 - (96.375,19.2,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.681e+10	3.465e-188	5.396e-24	2.972e-189	4.628e-25
0.02	1.296e+08	5.017e-87	9.117e-26	1.738e-88	3.158e-27
0.03	7.971e+10	1.485e-26	3.607e-22	1.472e-28	3.575e-24
0.04	2.118e+10	8.178e-12	2.669e-10	3.617e-14	1.180e-12
0.05	6.155e+08	1.584e-07	8.308e-06	4.220e-10	2.213e-08
0.06	7.438e+08	1.022e-04	5.715e-03	2.030e-07	1.135e-05
0.08	1.878e+08	5.750e-03	2.240e-01	9.099e-06	3.544e-04
0.1	2.512e+09	6.793e-01	1.739e+01	1.039e-03	2.661e-02
0.15	7.230e+06	1.489e-02	1.926e-01	2.452e-05	3.171e-04
0.2	5.821e+08	2.702e+00	2.459e+01	4.768e-03	4.339e-02
0.3	8.776e+08	9.576e+00	5.996e+01	1.816e-02	1.137e-01
0.4	5.651e+08	1.051e+01	5.292e+01	2.048e-02	1.031e-01

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK Consolidation tank 1880 gal decayed 8yr & 6yr plus A
 Run Date: December 2, 2004
 Run Time: 9:07:24 AM
 Duration : 00:00:32

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.5	4.628e+07	1.283e+00	5.527e+00	2.519e-03	1.085e-02
0.6	1.216e+12	4.651e+04	1.780e+05	9.078e+01	3.474e+02
0.8	2.157e+09	1.365e+02	4.399e+02	2.597e-01	8.368e-01
1.0	2.998e+10	2.802e+03	8.029e+03	5.165e+00	1.480e+01
1.5	2.970e+10	5.600e+03	1.327e+04	9.422e+00	2.233e+01
2.0	1.050e+08	3.209e+01	6.840e+01	4.963e-02	1.058e-01
3.0	1.436e+01	8.457e-06	1.584e-05	1.147e-08	2.149e-08
TOTALS:	1.402e+12	5.510e+04	1.999e+05	1.057e+02	3.858e+02

Results - Dose Point # 5 - (108.375,19.2,0) in					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.681e+10	2.895e-188	4.063e-24	2.483e-189	3.485e-25
0.02	1.296e+08	4.012e-87	6.865e-26	1.390e-88	2.378e-27
0.03	7.971e+10	1.328e-26	2.716e-22	1.316e-28	2.692e-24
0.04	2.118e+10	6.954e-12	2.262e-10	3.075e-14	1.000e-12
0.05	6.155e+08	1.276e-07	6.649e-06	3.399e-10	1.771e-08
0.06	7.438e+08	7.909e-05	4.370e-03	1.571e-07	8.681e-06
0.08	1.878e+08	4.242e-03	1.632e-01	6.712e-06	2.583e-04
0.1	2.512e+09	4.916e-01	1.245e+01	7.522e-04	1.905e-02
0.15	7.230e+06	1.061e-02	1.367e-01	1.747e-05	2.250e-04
0.2	5.821e+08	1.917e+00	1.745e+01	3.384e-03	3.080e-02
0.3	8.776e+08	6.786e+00	4.258e+01	1.287e-02	8.077e-02
0.4	5.651e+08	7.449e+00	3.759e+01	1.451e-02	7.325e-02
0.5	4.628e+07	9.093e-01	3.928e+00	1.785e-03	7.710e-03
0.6	1.216e+12	3.297e+04	1.266e+05	6.435e+01	2.470e+02
0.8	2.157e+09	9.683e+01	3.132e+02	1.842e-01	5.956e-01
1.0	2.998e+10	1.988e+03	5.721e+03	3.665e+00	1.055e+01
1.5	2.970e+10	3.981e+03	9.477e+03	6.697e+00	1.595e+01
2.0	1.050e+08	2.285e+01	4.895e+01	3.533e-02	7.570e-02
3.0	1.436e+01	6.038e-06	1.137e-05	8.192e-09	1.543e-08
TOTALS:	1.402e+12	3.907e+04	1.422e+05	7.496e+01	2.744e+02

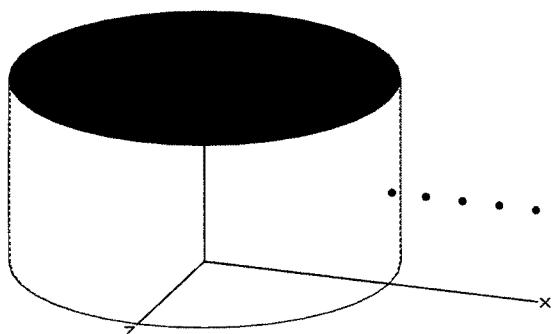
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
Run Date: November 1, 2004
Run Time: 4:53:32 PM
Duration : 00:00:32

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: TAN Vtank Process
Description: Vtank+ARA waste Decayed 8&6yr 2940 gal (1880 gal) no shield
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions			
Height	152.4 cm	5 ft 0.0 in	
Radius	152.4 cm	5 ft 0.0 in	
Dose Points			
# 1	X 155.89 cm 5 ft 1.4 in	Y 76.25 cm 2 ft 6.0 in	Z 0 cm 0.0 in
# 2	183.8325 cm 6 ft 0.4 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in
# 3	214.3125 cm 7 ft 0.4 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in
# 4	244.7925 cm 8 ft 0.4 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in
# 5	275.2725 cm 9 ft 0.4 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in
Shields			
Shield Name	Dimension	Material	Density
Source	6.79e+05 in ³	V123 SLUDGE	1.02
Shield 1	.375 in	304L	8
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm ³
Ac-225	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Ac-227	1.7700e-008	6.5490e+002	1.5917e-009	5.8894e-005
Ac-228	5.1800e-019	1.9166e-008	4.6583e-020	1.7236e-015
Ag-108	4.9600e-004	1.8352e+007	4.4604e-005	1.6504e+000
Ag-108m	5.3300e-003	1.9721e+008	4.7932e-004	1.7735e+001
Ag-110	3.5500e-008	1.3135e+003	3.1924e-009	1.1812e-004
Ag-110m	2.6700e-006	9.8790e+004	2.4011e-007	8.8840e-003
Am-241	5.5200e-002	2.0424e+009	4.9640e-003	1.8367e+002
Am-243	2.1600e-008	7.9920e+002	1.9424e-009	7.1871e-005
At-217	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Ba-137m	3.6500e+001	1.3505e+012	3.2824e+000	1.2145e+005
Bi-210	2.3300e-003	8.6210e+007	2.0953e-004	7.7527e+000
Bi-211	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Bi-212	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Bi-213	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Bi-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ce-144	4.8600e-005	1.7982e+006	4.3705e-006	1.6171e-001
Cm-242	8.4300e-010	3.1191e+001	7.5809e-011	2.8049e-006
Cm-243	1.0900e-002	4.0330e+008	9.8022e-004	3.6268e+001
Cm-244	9.7200e-003	3.5964e+008	8.7410e-004	3.2342e+001
Co-58	5.2800e-015	1.9536e-004	4.7482e-016	1.7568e-011
Co-60	7.4500e-001	2.7565e+010	6.6996e-002	2.4789e+003
Cs-134	8.5800e-004	3.1746e+007	7.7158e-005	2.8549e+000

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
Run Date: November 1, 2004
Run Time: 4:53:32 PM
Duration : 00:00:32

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Cs-137	3.8600e+001	1.4282e+012	3.4712e+000	1.2844e+005
Eu-152	7.3300e-002	2.7121e+009	6.5917e-003	2.4389e+002
Eu-154	9.9000e-002	3.6630e+009	8.9029e-003	3.2941e+002
Eu-155	6.7900e-003	2.5123e+008	6.1061e-004	2.2593e+001
Fe-55	1.3700e-008	5.0690e+002	1.2320e-009	4.5585e-005
Fr-221	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Fr-223	2.4400e-010	9.0280e+000	2.1942e-011	8.1187e-007
Gd-152	1.2600e-015	4.6620e-005	1.1331e-016	4.1924e-012
H-3	6.3900e-003	2.3643e+008	5.7464e-004	2.1262e+001
I-129	3.4400e-004	1.2728e+007	3.0935e-005	1.1446e+000
Mn-54	4.9300e-006	1.8241e+005	4.4335e-007	1.6404e-002
Nb-95	6.1000e-015	2.2570e-004	5.4856e-016	2.0297e-011
Nb-95m	2.3400e-017	8.6580e-007	2.1043e-018	7.7860e-014
Ni-63	5.2200e+000	1.9314e+011	4.6942e-001	1.7369e+004
Np-237	1.6800e-004	6.2160e+006	1.5108e-005	5.5899e-001
Np-239	2.1600e-008	7.9920e+002	1.9424e-009	7.1871e-005
Pa-231	1.5100e-007	5.5870e+003	1.3579e-008	5.0243e-004
Pa-233	1.6800e-004	6.2160e+006	1.5108e-005	5.5899e-001
Pa-234	8.6200e-007	3.1894e+004	7.7518e-008	2.8682e-003
Pa-234m	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Pb-209	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Pb-210	2.3400e-003	8.6580e+007	2.1043e-004	7.7860e+000
Pb-211	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Pb-212	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Pb-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Po-210	2.1900e-003	8.1030e+007	1.9694e-004	7.2869e+000
Po-211	4.6900e-011	1.7353e+000	4.2176e-012	1.5605e-007
Po-212	6.9400e-010	2.5678e+001	6.2410e-011	2.3092e-006
Po-213	2.0500e-005	7.5850e+005	1.8435e-006	6.8210e-002
Po-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Po-215	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Po-216	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Po-218	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Pr-144	4.8600e-005	1.7982e+006	4.3705e-006	1.6171e-001
Pr-144m	6.9500e-007	2.5715e+004	6.2500e-008	2.3125e-003
Pu-238	8.3400e-002	3.0858e+009	7.5000e-003	2.7750e+002
Pu-239	4.6300e-002	1.7131e+009	4.1637e-003	1.5406e+002
Pu-240	4.3200e-002	1.5984e+009	3.8849e-003	1.4374e+002
Ra-223	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Ra-224	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Ra-225	2.1100e-005	7.8070e+005	1.8975e-006	7.0207e-002
Ra-226	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ra-228	5.1800e-019	1.9166e-008	4.6583e-020	1.7236e-015
Rh-103m	9.6800e-023	3.5816e-012	8.7050e-024	3.2209e-019
Rh-106	2.6600e-004	9.8420e+006	2.3921e-005	8.8507e-001
Rn-219	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Rn-220	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Rn-222	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ru-103	9.7000e-023	3.5890e-012	8.7230e-024	3.2275e-019
Ru-106	2.6600e-004	9.8420e+006	2.3921e-005	8.8507e-001
Sb-125	3.5100e-003	1.2987e+008	3.1565e-004	1.1679e+001
Sr-90	6.8900e+001	2.5493e+012	6.1960e+000	2.2925e+005
Te-125m	8.5900e-004	3.1783e+007	7.7248e-005	2.8582e+000
Th-227	1.7100e-008	6.3270e+002	1.5378e-009	5.6897e-005
Th-228	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Th-229	2.1200e-005	7.8440e+005	1.9065e-006	7.0540e-002
Th-230	2.3200e-006	8.5840e+004	2.0863e-007	7.7194e-003
Th-231	8.9900e-004	3.3263e+007	8.0845e-005	2.9913e+000
Th-232	2.0200e-018	7.4740e-008	1.8165e-019	6.7212e-015
Th-234	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000

ENGINEERING DESIGN FILE

Page : 3
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 1, 2004
 Run Time: 4:53:32 PM
 Duration : 00:00:32

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
TI-207	1.7100e-008	6.3270e+002	1.5378e-009	5.6897e-005
TI-208	3.8900e-010	1.4393e+001	3.4982e-011	1.2943e-006
TI-209	4.5200e-007	1.6724e+004	4.0647e-008	1.5040e-003
U-233	2.8200e-002	1.0434e+009	2.5360e-003	9.3831e+001
U-234	3.3000e-002	1.2210e+009	2.9676e-003	1.0980e+002
U-235	8.9900e-004	3.3263e+007	8.0845e-005	2.9913e+000
U-236	1.0200e-008	3.7740e+002	9.1727e-010	3.3939e-005
U-238	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Y-90	6.8900e+001	2.5493e+012	6.1960e+000	2.2925e+005
Zn-65	2.7500e-006	1.0175e+005	2.4730e-007	9.1502e-003
Zr-95	2.7600e-015	1.0212e-004	2.4820e-016	9.1835e-012

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (6.14e+01,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	7.989e-224	6.967e-29	6.853e-225	5.976e-30
0.02	1.296e+08	1.535e-99	3.096e-25	5.319e-101	1.072e-26
0.03	7.971e+10	1.376e-29	1.225e-21	1.363e-31	1.214e-23
0.04	2.118e+10	9.116e-13	3.380e-11	4.032e-15	1.495e-13
0.05	6.155e+08	7.983e-08	4.861e-06	2.127e-10	1.295e-08
0.06	7.438e+08	9.431e-05	6.095e-03	1.873e-07	1.211e-05
0.08	1.878e+08	8.312e-03	3.647e-01	1.315e-05	5.772e-04
0.1	2.512e+09	1.162e+00	3.323e+01	1.777e-03	5.084e-02
0.15	7.230e+06	2.985e-02	4.406e-01	4.915e-05	7.255e-04
0.2	5.821e+08	5.758e+00	6.073e+01	1.016e-02	1.072e-01
0.3	8.776e+08	2.159e+01	1.576e+02	4.095e-02	2.989e-01
0.4	5.651e+08	2.447e+01	1.432e+02	4.767e-02	2.790e-01
0.5	4.628e+07	3.057e+00	1.525e+01	6.001e-03	2.993e-02
0.6	1.216e+12	1.130e+05	4.986e+05	2.205e+02	9.732e+02
0.8	2.157e+09	3.424e+02	1.263e+03	6.513e-01	2.403e+00
1.0	2.998e+10	7.214e+03	2.347e+04	1.330e+01	4.327e+01
1.5	2.970e+10	1.515e+04	4.014e+04	2.548e+01	6.754e+01
2.0	1.050e+08	8.971e+01	2.114e+02	1.387e-01	3.270e-01
3.0	1.436e+01	2.463e-05	5.016e-05	3.341e-08	6.805e-08
TOTALS:	1.385e+12	1.358e+05	5.641e+05	2.602e+02	1.087e+03

Results - Dose Point # 2 - (72.375,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	3.355e-194	4.115e-29	2.878e-195	3.530e-30
0.02	1.296e+08	3.653e-87	1.828e-25	1.265e-88	6.334e-27
0.03	7.971e+10	1.649e-26	7.233e-22	1.634e-28	7.169e-24
0.04	2.118e+10	7.342e-12	2.378e-10	3.247e-14	1.052e-12
0.05	6.155e+08	1.400e-07	7.424e-06	3.730e-10	1.978e-08
0.06	7.438e+08	9.925e-05	5.744e-03	1.971e-07	1.141e-05
0.08	1.878e+08	6.618e-03	2.776e-01	1.047e-05	4.393e-04
0.1	2.512e+09	8.781e-01	2.513e+01	1.343e-03	3.845e-02

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 1, 2004
 Run Time: 4:53:32 PM
 Duration : 00:00:32

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.15	7.230e+06	2.230e-02	3.308e-01	3.671e-05	5.447e-04
0.2	5.821e+08	4.286e+00	4.453e+01	7.565e-03	7.860e-02
0.3	8.776e+08	1.596e+01	1.125e+02	3.027e-02	2.134e-01
0.4	5.651e+08	1.798e+01	1.007e+02	3.503e-02	1.962e-01
0.5	4.628e+07	2.233e+00	1.061e+01	4.383e-03	2.083e-02
0.6	1.216e+12	8.206e+04	3.440e+05	1.602e+02	6.714e+02
0.8	2.157e+09	2.460e+02	8.588e+02	4.679e-01	1.634e+00
1.0	2.998e+10	5.129e+03	1.578e+04	9.454e+00	2.909e+01
1.5	2.970e+10	1.053e+04	2.639e+04	1.772e+01	4.440e+01
2.0	1.050e+08	6.132e+01	1.370e+02	9.483e-02	2.118e-01
3.0	1.436e+01	1.645e-05	3.194e-05	2.232e-08	4.333e-08
TOTALS:	1.385e+12	9.807e+04	3.874e+05	1.880e+02	7.473e+02

Results - Dose Point # 3 - (84.375,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	8.900e-194	2.746e-29	7.633e-195	2.355e-30
0.02	1.296e+08	4.101e-87	1.220e-25	1.421e-88	4.226e-27
0.03	7.971e+10	1.132e-26	4.827e-22	1.122e-28	4.783e-24
0.04	2.118e+10	5.933e-12	1.942e-10	2.624e-14	8.587e-13
0.05	6.155e+08	1.233e-07	6.532e-06	3.285e-10	1.740e-08
0.06	7.438e+08	8.497e-05	4.868e-03	1.688e-07	9.669e-06
0.08	1.878e+08	5.473e-03	2.267e-01	8.661e-06	3.588e-04
0.1	2.512e+09	7.066e-01	1.951e+01	1.081e-03	2.985e-02
0.15	7.230e+06	1.698e-02	2.372e-01	2.797e-05	3.906e-04
0.2	5.821e+08	3.182e+00	3.103e+01	5.616e-03	5.477e-02
0.3	8.776e+08	1.157e+01	7.676e+01	2.195e-02	1.456e-01
0.4	5.651e+08	1.287e+01	6.812e+01	2.507e-02	1.327e-01
0.5	4.628e+07	1.584e+00	7.139e+00	3.108e-03	1.401e-02
0.6	1.216e+12	5.777e+04	2.305e+05	1.128e+02	4.499e+02
0.8	2.157e+09	1.712e+02	5.721e+02	3.256e-01	1.088e+00
1.0	2.998e+10	3.539e+03	1.047e+04	6.523e+00	1.930e+01
1.5	2.970e+10	7.159e+03	1.740e+04	1.204e+01	2.928e+01
2.0	1.050e+08	4.133e+01	9.002e+01	6.391e-02	1.392e-01
3.0	1.436e+01	1.098e-05	2.092e-05	1.490e-08	2.838e-08
TOTALS:	1.385e+12	6.871e+04	2.592e+05	1.318e+02	5.001e+02

Results - Dose Point # 4 - (96.375,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	8.440e-194	1.984e-29	7.239e-195	1.702e-30
0.02	1.296e+08	3.209e-87	8.816e-26	1.112e-88	3.054e-27
0.03	7.971e+10	9.504e-27	3.488e-22	9.419e-29	3.457e-24
0.04	2.118e+10	5.271e-12	1.722e-10	2.331e-14	7.616e-13
0.05	6.155e+08	1.060e-07	5.602e-06	2.822e-10	1.492e-08
0.06	7.438e+08	7.223e-05	4.120e-03	1.435e-07	8.183e-06
0.08	1.878e+08	4.441e-03	1.793e-01	7.028e-06	2.837e-04
0.1	2.512e+09	5.505e-01	1.468e+01	8.421e-04	2.246e-02
0.15	7.230e+06	1.263e-02	1.698e-01	2.080e-05	2.796e-04
0.2	5.821e+08	2.326e+00	2.195e+01	4.105e-03	3.873e-02
0.3	8.776e+08	8.347e+00	5.397e+01	1.583e-02	1.024e-01
0.4	5.651e+08	9.224e+00	4.781e+01	1.797e-02	9.316e-02

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 1, 2004
 Run Time: 4:53:32 PM
 Duration : 00:00:32

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
0.5	4.628e+07	1.131e+00	5.006e+00	2.220e-03	9.827e-03
0.6	1.216e+12	4.114e+04	1.615e+05	8.031e+01	3.153e+02
0.8	2.157e+09	1.215e+02	4.006e+02	2.310e-01	7.619e-01
1.0	2.998e+10	2.504e+03	7.328e+03	4.615e+00	1.351e+01
1.5	2.970e+10	5.045e+03	1.217e+04	8.488e+00	2.048e+01
2.0	1.050e+08	2.906e+01	6.294e+01	4.494e-02	9.734e-02
3.0	1.436e+01	7.711e-06	1.464e-05	1.046e-08	1.986e-08
TOTALS:	1.385e+12	4.887e+04	1.816e+05	9.373e+01	3.504e+02

Results - Dose Point # 5 - (108.375,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
0.015	6.393e+04	7.042e-194	1.509e-29	6.040e-195	1.294e-30
0.02	1.296e+08	2.566e-87	6.706e-26	8.890e-89	2.323e-27
0.03	7.971e+10	8.516e-27	2.653e-22	8.440e-29	2.629e-24
0.04	2.118e+10	4.629e-12	1.510e-10	2.047e-14	6.680e-13
0.05	6.155e+08	9.155e-08	4.829e-06	2.439e-10	1.286e-08
0.06	7.438e+08	6.078e-05	3.430e-03	1.207e-07	6.812e-06
0.08	1.878e+08	3.539e-03	1.401e-01	5.600e-06	2.218e-04
0.1	2.512e+09	4.258e-01	1.111e+01	6.515e-04	1.700e-02
0.15	7.230e+06	9.493e-03	1.256e-01	1.563e-05	2.069e-04
0.2	5.821e+08	1.734e+00	1.617e+01	3.060e-03	2.854e-02
0.3	8.776e+08	6.189e+00	3.967e+01	1.174e-02	7.525e-02
0.4	5.651e+08	6.824e+00	3.511e+01	1.330e-02	6.840e-02
0.5	4.628e+07	8.356e-01	3.674e+00	1.640e-03	7.212e-03
0.6	1.216e+12	3.036e+04	1.185e+05	5.927e+01	2.313e+02
0.8	2.157e+09	8.952e+01	2.939e+02	1.703e-01	5.590e-01
1.0	2.998e+10	1.844e+03	5.377e+03	3.398e+00	9.911e+00
1.5	2.970e+10	3.710e+03	8.934e+03	6.241e+00	1.503e+01
2.0	1.050e+08	2.136e+01	4.625e+01	3.304e-02	7.152e-02
3.0	1.436e+01	5.671e-06	1.077e-05	7.694e-09	1.462e-08
TOTALS:	1.385e+12	3.604e+04	1.333e+05	6.914e+01	2.571e+02

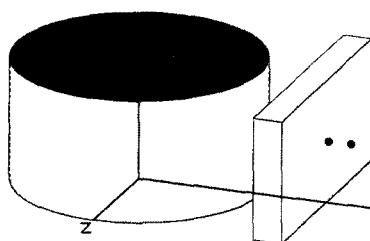
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 1, 2004
 Run Time: 4:35:46 PM
 Duration : 00:00:33

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: TAN V tank Process
Description: V-tank+ARA waste Decayed 8yr&6yr 2940 gal (1880 gal) 14" Con
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions			
Height	152.4 cm	5 ft 0.0 in	
Radius	152.4 cm	5 ft 0.0 in	

Dose Points			
#	X	Y	Z
# 1	237.1725 cm 7 ft 9.4 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in
# 2	265.1125 cm 8 ft 8.4 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in
# 3	326.0725 cm 10 ft 8.4 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in
# 4	417.5125 cm 13 ft 8.4 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in
# 5	508.9525 cm 16 ft 8.4 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in

Shields				
Shield Name	Dimension	Material	Density	
Source	6.79e+05 in ³	V123 SLUDGE	1.02	
Shield 1	.375 in	304L	8	
Transition	18.0 in	Air	0.00122	
Shield 3	14.0 in	Concrete	2.35	
Air Gap			Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm ³
Ac-225	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Ac-227	1.7700e-008	6.5490e+002	1.5917e-009	5.8894e-005
Ac-228	5.1800e-019	1.9166e-008	4.6583e-020	1.7236e-015
Ag-108	4.9600e-004	1.8352e+007	4.4604e-005	1.6504e+000
Ag-108m	5.3300e-003	1.9721e+008	4.7932e-004	1.7735e+001
Ag-110	3.5500e-008	1.3135e+003	3.1924e-009	1.1812e-004
Ag-110m	2.6700e-006	9.8790e+004	2.4011e-007	8.8840e-003
Am-241	5.5200e-002	2.0424e+009	4.9640e-003	1.8367e+002
Am-243	2.1600e-008	7.9920e+002	1.9424e-009	7.1871e-005
At-217	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Ba-137m	3.6500e+001	1.3505e+012	3.2824e+000	1.2145e+005
Bi-210	2.3300e-003	8.6210e+007	2.0953e-004	7.7527e+000
Bi-211	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Bi-212	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Bi-213	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Bi-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ce-144	4.8600e-005	1.7982e+006	4.3705e-006	1.6171e-001
Cm-242	8.4300e-010	3.1191e+001	7.5809e-011	2.8049e-006
Cm-243	1.0900e-002	4.0330e+008	9.8022e-004	3.6268e+001
Cm-244	9.7200e-003	3.5964e+008	8.7410e-004	3.2342e+001
Co-58	5.2800e-015	1.9536e-004	4.7482e-016	1.7568e-011
Co-60	7.4500e-001	2.7565e+010	6.6996e-002	2.4789e+003

Page : 2
DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
Run Date: November 1, 2004
Run Time: 4:35:46 PM
Duration : 00:00:33

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Cs-134	8.5800e-004	3.1746e+007	7.7158e-005	2.8549e+000
Cs-137	3.8600e+001	1.4282e+012	3.4712e+000	1.2844e+005
Eu-152	7.3300e-002	2.7121e+009	6.5917e-003	2.4389e+002
Eu-154	9.9000e-002	3.6630e+009	8.9029e-003	3.2941e+002
Eu-155	6.7900e-003	2.5123e+008	6.1061e-004	2.2593e+001
Fe-55	1.3700e-008	5.0690e+002	1.2320e-009	4.5585e-005
Fr-221	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Fr-223	2.4400e-010	9.0280e+000	2.1942e-011	8.1187e-007
Gd-152	1.2600e-015	4.6620e-005	1.1331e-016	4.1924e-012
H-3	6.3900e-003	2.3643e+008	5.7464e-004	2.1262e+001
I-129	3.4400e-004	1.2728e+007	3.0935e-005	1.1446e+000
Mn-54	4.9300e-006	1.8241e+005	4.4335e-007	1.6404e-002
Nb-95	6.1000e-015	2.2570e-004	5.4856e-016	2.0297e-011
Nb-95m	2.3400e-017	8.6580e-007	2.1043e-018	7.7860e-014
Ni-63	5.2200e+000	1.9314e+011	4.6942e-001	1.7369e+004
Np-237	1.6800e-004	6.2160e+006	1.5108e-005	5.5899e-001
Np-239	2.1600e-008	7.9920e+002	1.9424e-009	7.1871e-005
Pa-231	1.5100e-007	5.5870e+003	1.3579e-008	5.0243e-004
Pa-233	1.6800e-004	6.2160e+006	1.5108e-005	5.5899e-001
Pa-234	8.6200e-007	3.1894e+004	7.7518e-008	2.8682e-003
Pa-234m	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Pb-209	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Pb-210	2.3400e-003	8.6580e+007	2.1043e-004	7.7860e+000
Pb-211	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Pb-212	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Pb-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Po-210	2.1900e-003	8.1030e+007	1.9694e-004	7.2869e+000
Po-211	4.6900e-011	1.7353e+000	4.2176e-012	1.5605e-007
Po-212	6.9400e-010	2.5678e+001	6.2410e-011	2.3092e-006
Po-213	2.0500e-005	7.5850e+005	1.8435e-006	6.8210e-002
Po-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Po-215	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Po-216	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Po-218	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Pr-144	4.8600e-005	1.7982e+006	4.3705e-006	1.6171e-001
Pr-144m	6.9500e-007	2.5715e+004	6.2500e-008	2.3125e-003
Pu-238	8.3400e-002	3.0858e+009	7.5000e-003	2.7750e+002
Pu-239	4.6300e-002	1.7131e+009	4.1637e-003	1.5406e+002
Pu-240	4.3200e-002	1.5984e+009	3.8849e-003	1.4374e+002
Ra-223	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Ra-224	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Ra-225	2.1100e-005	7.8070e+005	1.8975e-006	7.0207e-002
Ra-226	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ra-228	5.1800e-019	1.9166e-008	4.6583e-020	1.7236e-015
Rh-103m	9.6800e-023	3.5816e-012	8.7050e-024	3.2209e-019
Rh-106	2.6600e-004	9.8420e+006	2.3921e-005	8.8507e-001
Rn-219	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Rn-220	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Rn-222	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ru-103	9.7000e-023	3.5890e-012	8.7230e-024	3.2275e-019
Ru-106	2.6600e-004	9.8420e+006	2.3921e-005	8.8507e-001
Sb-125	3.5100e-003	1.2987e+008	3.1565e-004	1.1679e+001
Sr-90	6.8900e+001	2.5493e+012	6.1960e+000	2.2925e+005
Te-125m	8.5900e-004	3.1783e+007	7.7248e-005	2.8582e+000
Th-227	1.7100e-008	6.3270e+002	1.5378e-009	5.6897e-005
Th-228	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Th-229	2.1200e-005	7.8440e+005	1.9065e-006	7.0540e-002
Th-230	2.3200e-006	8.5840e+004	2.0863e-007	7.7194e-003
Th-231	8.9900e-004	3.3263e+007	8.0845e-005	2.9913e+000
Th-232	2.0200e-018	7.4740e-008	1.8165e-019	6.7212e-015

ENGINEERING DESIGN FILE

Page : 3
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 1, 2004
 Run Time: 4:35:46 PM
 Duration : 00:00:33

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Th-234	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Tl-207	1.7100e-008	6.3270e+002	1.5378e-009	5.6897e-005
Tl-208	3.8900e-010	1.4393e+001	3.4982e-011	1.2943e-006
Tl-209	4.5200e-007	1.6724e+004	4.0647e-008	1.5040e-003
U-233	2.8200e-002	1.0434e+009	2.5360e-003	9.3831e+001
U-234	3.3000e-002	1.2210e+009	2.9676e-003	1.0980e+002
U-235	8.9900e-004	3.3263e+007	8.0845e-005	2.9913e+000
U-236	1.0200e-008	3.7740e+002	9.1727e-010	3.3939e-005
U-238	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Y-90	6.8900e+001	2.5493e+012	6.1960e+000	2.2925e+005
Zn-65	2.7500e-006	1.0175e+005	2.4730e-007	9.1502e-003
Zr-95	2.7600e-015	1.0212e-004	2.4820e-016	9.1835e-012

Buildup
The material reference is : Shield 3

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (93.375,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	0.000e+00	1.591e-29	0.000e+00	1.364e-30
0.02	1.296e+08	7.645e-215	5.075e-26	2.648e-216	1.758e-27
0.03	7.971e+10	1.830e-68	6.901e-23	1.814e-70	6.840e-25
0.04	2.118e+10	5.989e-33	4.862e-23	2.649e-35	2.150e-25
0.05	6.155e+08	2.828e-21	2.813e-20	7.534e-24	7.493e-23
0.06	7.438e+08	3.461e-15	7.150e-14	6.875e-18	1.420e-16
0.08	1.878e+08	1.000e-10	3.957e-09	1.582e-13	6.262e-12
0.1	2.512e+09	1.470e-07	9.184e-06	2.248e-10	1.405e-08
0.15	7.230e+06	4.347e-08	3.795e-06	7.159e-11	6.250e-09
0.2	5.821e+08	2.860e-05	2.476e-03	5.048e-08	4.370e-06
0.3	8.776e+08	4.848e-04	3.110e-02	9.195e-07	5.900e-05
0.4	5.651e+08	1.486e-03	6.848e-02	2.895e-06	1.334e-04
0.5	4.628e+07	3.877e-04	1.338e-02	7.610e-07	2.627e-05
0.6	1.216e+12	2.549e+01	6.900e+02	4.975e-02	1.347e+00
0.8	2.157e+09	1.834e-01	3.374e+00	3.488e-04	6.418e-03
1.0	2.998e+10	7.257e+00	9.922e+01	1.338e-02	1.829e-01
1.5	2.970e+10	4.313e+01	3.616e+02	7.256e-02	6.084e-01
2.0	1.050e+08	4.807e-01	3.000e+00	7.433e-04	4.638e-03
3.0	1.436e+01	2.747e-07	1.195e-06	3.727e-10	1.621e-09
TOTALS:	1.385e+12	7.654e+01	1.157e+03	1.368e-01	2.149e+00

Results - Dose Point # 2 - (104.375,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	0.000e+00	1.223e-29	0.000e+00	1.049e-30
0.02	1.296e+08	6.578e-215	3.903e-26	2.279e-216	1.352e-27
0.03	7.971e+10	1.617e-68	5.307e-23	1.603e-70	5.260e-25
0.04	2.118e+10	5.689e-33	3.739e-23	2.516e-35	1.654e-25
0.05	6.155e+08	2.635e-21	2.620e-20	7.019e-24	6.979e-23
0.06	7.438e+08	3.221e-15	6.655e-14	6.398e-18	1.322e-16
0.08	1.878e+08	9.386e-11	3.711e-09	1.485e-13	5.873e-12

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 1, 2004
 Run Time: 4:35:46 PM
 Duration : 00:00:33

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.1	2.512e+09	1.381e-07	8.606e-06	2.114e-10	1.317e-08
0.15	7.230e+06	4.071e-08	3.523e-06	6.703e-11	5.802e-09
0.2	5.821e+08	2.662e-05	2.276e-03	4.698e-08	4.016e-06
0.3	8.776e+08	4.458e-04	2.813e-02	8.457e-07	5.336e-05
0.4	5.651e+08	1.352e-03	6.117e-02	2.635e-06	1.192e-04
0.5	4.628e+07	3.496e-04	1.183e-02	6.862e-07	2.322e-05
0.6	1.216e+12	2.279e+01	6.048e+02	4.449e-02	1.180e+00
0.8	2.157e+09	1.617e-01	2.915e+00	3.076e-04	5.544e-03
1.0	2.998e+10	6.325e+00	8.472e+01	1.166e-02	1.562e-01
1.5	2.970e+10	3.677e+01	3.024e+02	6.186e-02	5.088e-01
2.0	1.050e+08	4.037e-01	2.474e+00	6.242e-04	3.826e-03
3.0	1.436e+01	2.264e-07	9.695e-07	3.072e-10	1.315e-09
TOTALS:	1.385e+12	6.645e+01	9.974e+02	1.189e-01	1.855e+00

Results - Dose Point # 3 - (128.375,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	0.000e+00	7.674e-30	0.000e+00	6.583e-31
0.02	1.296e+08	4.731e-215	2.449e-26	1.639e-216	8.482e-28
0.03	7.971e+10	1.399e-68	3.329e-23	1.387e-70	3.300e-25
0.04	2.118e+10	4.867e-33	2.346e-23	2.153e-35	1.037e-25
0.05	6.155e+08	2.241e-21	2.229e-20	5.971e-24	5.937e-23
0.06	7.438e+08	2.742e-15	5.655e-14	5.447e-18	1.123e-16
0.08	1.878e+08	7.850e-11	3.086e-09	1.242e-13	4.883e-12
0.1	2.512e+09	1.137e-07	7.004e-06	1.740e-10	1.072e-08
0.15	7.230e+06	3.270e-08	2.771e-06	5.386e-11	4.563e-09
0.2	5.821e+08	2.103e-05	1.750e-03	3.712e-08	3.089e-06
0.3	8.776e+08	3.435e-04	2.101e-02	6.515e-07	3.986e-05
0.4	5.651e+08	1.022e-03	4.477e-02	1.990e-06	8.724e-05
0.5	4.628e+07	2.600e-04	8.525e-03	5.103e-07	1.673e-05
0.6	1.216e+12	1.673e+01	4.304e+02	3.266e-02	8.401e-01
0.8	2.157e+09	1.162e-01	2.034e+00	2.210e-04	3.869e-03
1.0	2.998e+10	4.472e+00	5.826e+01	8.243e-03	1.074e-01
1.5	2.970e+10	2.526e+01	2.029e+02	4.251e-02	3.413e-01
2.0	1.050e+08	2.724e-01	1.635e+00	4.212e-04	2.528e-03
3.0	1.436e+01	1.496e-07	6.297e-07	2.029e-10	8.543e-10
TOTALS:	1.385e+12	4.686e+01	6.953e+02	8.405e-02	1.295e+00

Results - Dose Point # 4 - (164.375,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	0.000e+00	4.505e-30	0.000e+00	3.864e-31
0.02	1.296e+08	3.352e-215	1.437e-26	1.161e-216	4.979e-28
0.03	7.971e+10	1.129e-68	1.954e-23	1.119e-70	1.937e-25
0.04	2.118e+10	3.836e-33	1.377e-23	1.696e-35	6.090e-26
0.05	6.155e+08	1.723e-21	1.712e-20	4.590e-24	4.561e-23
0.06	7.438e+08	2.031e-15	4.167e-14	4.034e-18	8.278e-17
0.08	1.878e+08	5.540e-11	2.161e-09	8.768e-14	3.419e-12
0.1	2.512e+09	7.840e-08	4.769e-06	1.199e-10	7.296e-09
0.15	7.230e+06	2.197e-08	1.827e-06	3.618e-11	3.008e-09
0.2	5.821e+08	1.392e-05	1.133e-03	2.457e-08	2.000e-06
0.3	8.776e+08	2.228e-04	1.332e-02	4.226e-07	2.526e-05

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 1, 2004
 Run Time: 4:35:46 PM
 Duration : 00:00:33

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.1	2.512e+09	1.381e-07	8.606e-06	2.114e-10	1.317e-08
0.15	7.230e+06	4.071e-08	3.523e-06	6.703e-11	5.802e-09
0.2	5.821e+08	2.662e-05	2.276e-03	4.698e-08	4.016e-06
0.3	8.776e+08	4.458e-04	2.813e-02	8.457e-07	5.336e-05
0.4	5.651e+08	1.352e-03	6.117e-02	2.635e-06	1.192e-04
0.5	4.628e+07	3.496e-04	1.183e-02	6.862e-07	2.322e-05
0.6	1.216e+12	2.279e+01	6.048e+02	4.449e-02	1.180e+00
0.8	2.157e+09	1.617e-01	2.915e+00	3.076e-04	5.544e-03
1.0	2.998e+10	6.325e+00	8.472e+01	1.166e-02	1.562e-01
1.5	2.970e+10	3.677e+01	3.024e+02	6.186e-02	5.088e-01
2.0	1.050e+08	4.037e-01	2.474e+00	6.242e-04	3.826e-03
3.0	1.436e+01	2.264e-07	9.695e-07	3.072e-10	1.315e-09
TOTALS:	1.385e+12	6.645e+01	9.974e+02	1.189e-01	1.855e+00

Results - Dose Point # 3 - (128.375,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	0.000e+00	7.674e-30	0.000e+00	6.583e-31
0.02	1.296e+08	4.731e-215	2.449e-26	1.639e-216	8.482e-28
0.03	7.971e+10	1.399e-68	3.329e-23	1.387e-70	3.300e-25
0.04	2.118e+10	4.867e-33	2.346e-23	2.153e-35	1.037e-25
0.05	6.155e+08	2.241e-21	2.229e-20	5.971e-24	5.937e-23
0.06	7.438e+08	2.742e-15	5.655e-14	5.447e-18	1.123e-16
0.08	1.878e+08	7.850e-11	3.086e-09	1.242e-13	4.883e-12
0.1	2.512e+09	1.137e-07	7.004e-06	1.740e-10	1.072e-08
0.15	7.230e+06	3.270e-08	2.771e-06	5.386e-11	4.563e-09
0.2	5.821e+08	2.103e-05	1.750e-03	3.712e-08	3.089e-06
0.3	8.776e+08	3.435e-04	2.101e-02	6.515e-07	3.986e-05
0.4	5.651e+08	1.022e-03	4.477e-02	1.990e-06	8.724e-05
0.5	4.628e+07	2.600e-04	8.525e-03	5.103e-07	1.673e-05
0.6	1.216e+12	1.673e+01	4.304e+02	3.266e-02	8.401e-01
0.8	2.157e+09	1.162e-01	2.034e+00	2.210e-04	3.869e-03
1.0	2.998e+10	4.472e+00	5.826e+01	8.243e-03	1.074e-01
1.5	2.970e+10	2.526e+01	2.029e+02	4.251e-02	3.413e-01
2.0	1.050e+08	2.724e-01	1.635e+00	4.212e-04	2.528e-03
3.0	1.436e+01	1.496e-07	6.297e-07	2.029e-10	8.543e-10
TOTALS:	1.385e+12	4.686e+01	6.953e+02	8.405e-02	1.295e+00

Results - Dose Point # 4 - (164.375,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	0.000e+00	4.505e-30	0.000e+00	3.864e-31
0.02	1.296e+08	3.352e-215	1.437e-26	1.161e-216	4.979e-28
0.03	7.971e+10	1.129e-68	1.954e-23	1.119e-70	1.937e-25
0.04	2.118e+10	3.836e-33	1.377e-23	1.696e-35	6.090e-26
0.05	6.155e+08	1.723e-21	1.712e-20	4.590e-24	4.561e-23
0.06	7.438e+08	2.031e-15	4.167e-14	4.034e-18	8.278e-17
0.08	1.878e+08	5.540e-11	2.161e-09	8.768e-14	3.419e-12
0.1	2.512e+09	7.840e-08	4.769e-06	1.199e-10	7.296e-09
0.15	7.230e+06	2.197e-08	1.827e-06	3.618e-11	3.008e-09
0.2	5.821e+08	1.392e-05	1.133e-03	2.457e-08	2.000e-06
0.3	8.776e+08	2.228e-04	1.332e-02	4.226e-07	2.526e-05

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 1, 2004
 Run Time: 4:35:46 PM
 Duration : 00:00:33

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.4	5.651e+08	6.531e-04	2.800e-02	1.273e-06	5.455e-05
0.5	4.628e+07	1.644e-04	5.277e-03	3.227e-07	1.036e-05
0.6	1.216e+12	1.049e+01	2.644e+02	2.047e-02	5.161e-01
0.8	2.157e+09	7.188e-02	1.235e+00	1.367e-04	2.350e-03
1.0	2.998e+10	2.739e+00	3.509e+01	5.048e-03	6.469e-02
1.5	2.970e+10	1.522e+01	1.206e+02	2.561e-02	2.029e-01
2.0	1.050e+08	1.625e-01	9.643e-01	2.513e-04	1.491e-03
3.0	1.436e+01	8.825e-08	3.684e-07	1.197e-10	4.998e-10
TOTALS:	1.385e+12	2.868e+01	4.223e+02	5.152e-02	7.876e-01

Results - Dose Point # 5 - (200.375,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	0.000e+00	2.975e-30	0.000e+00	2.551e-31
0.02	1.296e+08	2.600e-215	9.490e-27	9.005e-217	3.287e-28
0.03	7.971e+10	9.113e-69	1.290e-23	9.031e-71	1.279e-25
0.04	2.118e+10	2.993e-33	9.092e-24	1.324e-35	4.021e-26
0.05	6.155e+08	1.283e-21	1.274e-20	3.418e-24	3.394e-23
0.06	7.438e+08	1.465e-15	2.997e-14	2.910e-18	5.953e-17
0.08	1.878e+08	3.878e-11	1.506e-09	6.138e-14	2.384e-12
0.1	2.512e+09	5.427e-08	3.282e-06	8.302e-11	5.021e-09
0.15	7.230e+06	1.504e-08	1.240e-06	2.476e-11	2.041e-09
0.2	5.821e+08	9.469e-06	7.639e-04	1.671e-08	1.348e-06
0.3	8.776e+08	1.503e-04	8.907e-03	2.852e-07	1.690e-05
0.4	5.651e+08	4.384e-04	1.863e-02	8.542e-07	3.630e-05
0.5	4.628e+07	1.099e-04	3.499e-03	2.157e-07	6.868e-06
0.6	1.216e+12	6.987e+00	1.748e+02	1.364e-02	3.412e-01
0.8	2.157e+09	4.764e-02	8.131e-01	9.062e-05	1.547e-03
1.0	2.998e+10	1.808e+00	2.303e+01	3.334e-03	4.245e-02
1.5	2.970e+10	9.989e+00	7.876e+01	1.681e-02	1.325e-01
2.0	1.050e+08	1.063e-01	6.281e-01	1.643e-04	9.713e-04
3.0	1.436e+01	5.750e-08	2.394e-07	7.802e-11	3.248e-10
TOTALS:	1.385e+12	1.894e+01	2.781e+02	3.403e-02	5.187e-01

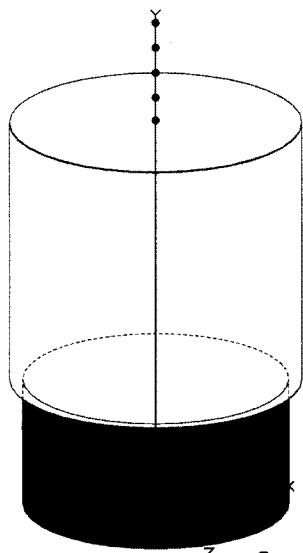
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEE

Page : 1
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 11, 2004
 Run Time: 7:19:55 AM
 Duration : 00:00:02

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: TAN V tank Process
Description: V-tank+ARA waste Decayed 8yr & 6yr 2940 gal 1880 gal top no
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions			
Height	X	Y	Z
152.4 cm	152.4 cm	5 ft 0.0 in	5 ft 0.0 in
Radius			

Dose Points			
#	X	Y	Z
# 1	0 cm	469.3285 cm	0 cm
	0.0 in	15 ft 4.8 in	0.0 in
# 2	0 cm	497.2685 cm	0 cm
	0.0 in	16 ft 3.8 in	0.0 in
# 3	0 cm	527.7485 cm	0 cm
	0.0 in	17 ft 3.8 in	0.0 in
# 4	0 cm	558.2285 cm	0 cm
	0.0 in	18 ft 3.8 in	0.0 in
# 5	0 cm	588.7085 cm	0 cm
	0.0 in	19 ft 3.8 in	0.0 in

Shields			
Shield Name	Dimension	Material	Density
Source	6.79e+05 in ³	V123 SLUDGE	1.02
Shield 1	123.4 in	Air	0.00122
Shield 2	.375 in	304L	8
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Ac-227	1.7700e-008	6.5490e+002	1.5917e-009	5.8894e-005
Ac-228	5.1800e-019	1.9166e-008	4.6583e-020	1.7236e-015
Ag-108	4.9600e-004	1.8352e+007	4.4604e-005	1.6504e+000
Ag-108m	5.3300e-003	1.9721e+008	4.7932e-004	1.7735e+001
Ag-110	3.5500e-008	1.3135e+003	3.1924e-009	1.1812e-004
Ag-110m	2.6700e-006	9.8790e+004	2.4011e-007	8.8840e-003
Am-241	5.5200e-002	2.0424e+009	4.9640e-003	1.8367e+002
Am-243	2.1600e-008	7.9920e+002	1.9424e-009	7.1871e-005
At-217	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Ba-137m	3.6500e+001	1.3505e+012	3.2824e+000	1.2145e+005
Bi-210	2.3300e-003	8.6210e+007	2.0953e-004	7.7527e+000
Bi-211	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Bi-212	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Bi-213	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Bi-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ce-144	4.8600e-005	1.7982e+006	4.3705e-006	1.6171e-001
Cm-242	8.4300e-010	3.1191e+001	7.5809e-011	2.8049e-006
Cm-243	1.0900e-002	4.0330e+008	9.8022e-004	3.6268e+001
Cm-244	9.7200e-003	3.5964e+008	8.7410e-004	3.2342e+001
Co-58	5.2800e-015	1.9536e-004	4.7482e-016	1.7568e-011
Co-60	7.4500e-001	2.7565e+010	6.6996e-002	2.4789e+003
Cs-134	8.5800e-004	3.1746e+007	7.7158e-005	2.8549e+000

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
Run Date: November 11, 2004
Run Time: 7:19:55 AM
Duration : 00:00:02

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Cs-137	3.8600e+001	1.4282e+012	3.4712e+000	1.2844e+005
Eu-152	7.3300e-002	2.7121e+009	6.5917e-003	2.4389e+002
Eu-154	9.9000e-002	3.6630e+009	8.9029e-003	3.2941e+002
Eu-155	6.7900e-003	2.5123e+008	6.1061e-004	2.2593e+001
Fe-55	1.3700e-008	5.0690e+002	1.2320e-009	4.5585e-005
Fr-221	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Fr-223	2.4400e-010	9.0280e+000	2.1942e-011	8.1187e-007
Gd-152	1.2600e-015	4.6620e-005	1.1331e-016	4.1924e-012
H-3	6.3900e-003	2.3643e+008	5.7464e-004	2.1262e+001
I-129	3.4400e-004	1.2728e+007	3.0935e-005	1.1446e+000
Mn-54	4.9300e-006	1.8241e+005	4.4335e-007	1.6404e-002
Nb-95	6.1000e-015	2.2570e-004	5.4856e-016	2.0297e-011
Nb-95m	2.3400e-017	8.6580e-007	2.1043e-018	7.7860e-014
Ni-63	5.2200e+000	1.9314e+011	4.6942e-001	1.7369e+004
Np-237	1.6800e-004	6.2160e+006	1.5108e-005	5.5899e-001
Np-239	2.1600e-008	7.9920e+002	1.9424e-009	7.1871e-005
Pa-231	1.5100e-007	5.5870e+003	1.3579e-008	5.0243e-004
Pa-233	1.6800e-004	6.2160e+006	1.5108e-005	5.5899e-001
Pa-234	8.6200e-007	3.1894e+004	7.7518e-008	2.8682e-003
Pa-234m	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Pb-209	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Pb-210	2.3400e-003	8.6580e+007	2.1043e-004	7.7860e+000
Pb-211	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Pb-212	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Pb-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Po-210	2.1900e-003	8.1030e+007	1.9694e-004	7.2869e+000
Po-211	4.6900e-011	1.7353e+000	4.2176e-012	1.5605e-007
Po-212	6.9400e-010	2.5678e+001	6.2410e-011	2.3092e-006
Po-213	2.0500e-005	7.5850e+005	1.8435e-006	6.8210e-002
Po-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Po-215	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Po-216	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Po-218	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Pr-144	4.8600e-005	1.7982e+006	4.3705e-006	1.6171e-001
Pr-144m	6.9500e-007	2.5715e+004	6.2500e-008	2.3125e-003
Pu-238	8.3400e-002	3.0858e+009	7.5000e-003	2.7750e+002
Pu-239	4.6300e-002	1.7131e+009	4.1637e-003	1.5406e+002
Pu-240	4.3200e-002	1.5984e+009	3.8849e-003	1.4374e+002
Ra-223	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Ra-224	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Ra-225	2.1100e-005	7.8070e+005	1.8975e-006	7.0207e-002
Ra-226	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ra-228	5.1800e-019	1.9166e-008	4.6583e-020	1.7236e-015
Rh-103m	9.6800e-023	3.5816e-012	8.7050e-024	3.2209e-019
Rh-106	2.6600e-004	9.8420e+006	2.3921e-005	8.8507e-001
Rn-219	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Rn-220	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Rn-222	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ru-103	9.7000e-023	3.5890e-012	8.7230e-024	3.2275e-019
Ru-106	2.6600e-004	9.8420e+006	2.3921e-005	8.8507e-001
Sb-125	3.5100e-003	1.2987e+008	3.1565e-004	1.1679e+001
Sr-90	6.8900e+001	2.5493e+012	6.1960e+000	2.2925e+005
Te-125m	8.5900e-004	3.1783e+007	7.7248e-005	2.8582e+000
Th-227	1.7100e-008	6.3270e+002	1.5378e-009	5.6897e-005
Th-228	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Th-229	2.1200e-005	7.8440e+005	1.9065e-006	7.0540e-002
Th-230	2.3200e-006	8.5840e+004	2.0863e-007	7.7194e-003
Th-231	8.9900e-004	3.3263e+007	8.0845e-005	2.9913e+000
Th-232	2.0200e-018	7.4740e-008	1.8165e-019	6.7212e-015
Th-234	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000

ENGINEERING DESIGN FILE

Page : 3
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 11, 2004
 Run Time: 7:19:55 AM
 Duration : 00:00:02

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Tl-207	1.7100e-008	6.3270e+002	1.5378e-009	5.6897e-005
Tl-208	3.8900e-010	1.4393e+001	3.4982e-011	1.2943e-006
Tl-209	4.5200e-007	1.6724e+004	4.0647e-008	1.5040e-003
U-233	2.8200e-002	1.0434e+009	2.5360e-003	9.3831e+001
U-234	3.3000e-002	1.2210e+009	2.9676e-003	1.0980e+002
U-235	8.9900e-004	3.3263e+007	8.0845e-005	2.9913e+000
U-236	1.0200e-008	3.7740e+002	9.1727e-010	3.3939e-005
U-238	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Y-90	6.8900e+001	2.5493e+012	6.1960e+000	2.2925e+005
Zn-65	2.7500e-006	1.0175e+005	2.4730e-007	9.1502e-003
Zr-95	2.7600e-015	1.0212e-004	2.4820e-016	9.1835e-012

Buildup

The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (0,184.775,0) in

<u>Energy MeV</u>	<u>Activity photons/sec</u>	<u>Fluence Rate MeV/cm²/sec</u>	<u>Fluence Rate MeV/cm²/sec</u>	<u>Exposure Rate mR/hr</u>	<u>Exposure Rate mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.681e+10	1.891e-188	1.635e-24	1.622e-189	1.402e-25
0.02	1.296e+08	3.717e-87	2.762e-26	1.288e-88	9.567e-28
0.03	7.971e+10	1.449e-26	1.093e-22	1.436e-28	1.083e-24
0.04	2.118e+10	7.570e-12	2.465e-10	3.348e-14	1.090e-12
0.05	6.155e+08	1.341e-07	6.937e-06	3.572e-10	1.848e-08
0.06	7.438e+08	7.701e-05	4.159e-03	1.530e-07	8.260e-06
0.08	1.878e+08	3.567e-03	1.297e-01	5.645e-06	2.053e-04
0.1	2.512e+09	3.734e-01	8.743e+00	5.712e-04	1.338e-02
0.15	7.230e+06	7.149e-03	8.438e-02	1.177e-05	1.389e-04
0.2	5.821e+08	1.236e+00	1.035e+01	2.182e-03	1.827e-02
0.3	8.776e+08	4.224e+00	2.464e+01	8.012e-03	4.674e-02
0.4	5.651e+08	4.560e+00	2.156e+01	8.884e-03	4.201e-02
0.5	4.628e+07	5.505e-01	2.241e+00	1.081e-03	4.400e-03
0.6	1.216e+12	1.979e+04	7.198e+04	3.863e+01	1.405e+02
0.8	2.157e+09	5.742e+01	1.772e+02	1.092e-01	3.370e-01
1.0	2.998e+10	1.168e+03	3.227e+03	2.154e+00	5.948e+00
1.5	2.970e+10	2.304e+03	5.312e+03	3.877e+00	8.937e+00
2.0	1.050e+08	1.311e+01	2.732e+01	2.028e-02	4.225e-02
3.0	1.436e+01	3.435e-06	6.314e-06	4.660e-09	8.567e-09
TOTALS:	1.402e+12	2.335e+04	8.079e+04	4.481e+01	1.559e+02

Results - Dose Point # 2 - (0,195.775,0) in

<u>Energy MeV</u>	<u>Activity photons/sec</u>	<u>Fluence Rate MeV/cm²/sec</u>	<u>Fluence Rate MeV/cm²/sec</u>	<u>Exposure Rate mR/hr</u>	<u>Exposure Rate mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.681e+10	1.795e-188	1.435e-24	1.540e-189	1.231e-25
0.02	1.296e+08	3.627e-87	2.425e-26	1.256e-88	8.401e-28
0.03	7.971e+10	1.430e-26	9.594e-23	1.417e-28	9.508e-25
0.04	2.118e+10	7.297e-12	2.372e-10	3.227e-14	1.049e-12
0.05	6.155e+08	1.247e-07	6.425e-06	3.323e-10	1.711e-08
0.06	7.438e+08	6.987e-05	3.750e-03	1.388e-07	7.449e-06
0.08	1.878e+08	3.157e-03	1.141e-01	4.996e-06	1.806e-04
0.1	2.512e+09	3.272e-01	7.626e+00	5.006e-04	1.167e-02

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 11, 2004
 Run Time: 7:19:55 AM
 Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.15	7.230e+06	6.220e-03	7.326e-02	1.024e-05	1.206e-04
0.2	5.821e+08	1.074e+00	8.983e+00	1.895e-03	1.586e-02
0.3	8.776e+08	3.664e+00	2.138e+01	6.951e-03	4.056e-02
0.4	5.651e+08	3.955e+00	1.871e+01	7.706e-03	3.646e-02
0.5	4.628e+07	4.775e-01	1.946e+00	9.372e-04	3.819e-03
0.6	1.216e+12	1.717e+04	6.249e+04	3.351e+01	1.220e+02
0.8	2.157e+09	4.981e+01	1.539e+02	9.474e-02	2.927e-01
1.0	2.998e+10	1.014e+03	2.803e+03	1.869e+00	5.167e+00
1.5	2.970e+10	2.000e+03	4.618e+03	3.366e+00	7.769e+00
2.0	1.050e+08	1.139e+01	2.377e+01	1.761e-02	3.675e-02
3.0	1.436e+01	2.986e-06	5.497e-06	4.050e-09	7.458e-09
TOTALS:	1.402e+12	2.025e+04	7.015e+04	3.887e+01	1.354e+02

Results - Dose Point # 3 - (0,207.775,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.681e+10	1.696e-188	1.250e-24	1.455e-189	1.072e-25
0.02	1.296e+08	3.531e-87	2.111e-26	1.223e-88	7.314e-28
0.03	7.971e+10	1.406e-26	8.353e-23	1.394e-28	8.278e-25
0.04	2.118e+10	6.958e-12	2.258e-10	3.077e-14	9.986e-13
0.05	6.155e+08	1.147e-07	5.884e-06	3.056e-10	1.567e-08
0.06	7.438e+08	6.277e-05	3.351e-03	1.247e-07	6.656e-06
0.08	1.878e+08	2.774e-03	9.974e-02	4.390e-06	1.578e-04
0.1	2.512e+09	2.851e-01	6.619e+00	4.361e-04	1.013e-02
0.15	7.230e+06	5.384e-03	6.334e-02	8.865e-06	1.043e-04
0.2	5.821e+08	9.279e-01	7.765e+00	1.638e-03	1.370e-02
0.3	8.776e+08	3.165e+00	1.848e+01	6.004e-03	3.506e-02
0.4	5.651e+08	3.416e+00	1.618e+01	6.656e-03	3.152e-02
0.5	4.628e+07	4.124e-01	1.683e+00	8.095e-04	3.303e-03
0.6	1.216e+12	1.483e+04	5.406e+04	2.895e+01	1.055e+02
0.8	2.157e+09	4.304e+01	1.332e+02	8.186e-02	2.533e-01
1.0	2.998e+10	8.762e+02	2.427e+03	1.615e+00	4.473e+00
1.5	2.970e+10	1.730e+03	4.000e+03	2.911e+00	6.731e+00
2.0	1.050e+08	9.856e+00	2.060e+01	1.524e-02	3.186e-02
3.0	1.436e+01	2.586e-06	4.769e-06	3.508e-09	6.470e-09
TOTALS:	1.402e+12	1.750e+04	6.069e+04	3.359e+01	1.171e+02

Results - Dose Point # 4 - (0,219.775,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.681e+10	1.602e-188	1.099e-24	1.374e-189	9.427e-26
0.02	1.296e+08	3.437e-87	1.857e-26	1.191e-88	6.433e-28
0.03	7.971e+10	1.379e-26	7.347e-23	1.366e-28	7.281e-25
0.04	2.118e+10	6.591e-12	2.135e-10	2.915e-14	9.443e-13
0.05	6.155e+08	1.052e-07	5.374e-06	2.801e-10	1.432e-08
0.06	7.438e+08	5.641e-05	2.998e-03	1.120e-07	5.956e-06
0.08	1.878e+08	2.448e-03	8.769e-02	3.874e-06	1.388e-04
0.1	2.512e+09	2.498e-01	5.786e+00	3.822e-04	8.853e-03
0.15	7.230e+06	4.695e-03	5.524e-02	7.731e-06	9.096e-05
0.2	5.821e+08	8.083e-01	6.770e+00	1.427e-03	1.195e-02
0.3	8.776e+08	2.756e+00	1.612e+01	5.229e-03	3.057e-02
0.4	5.651e+08	2.975e+00	1.411e+01	5.797e-03	2.750e-02

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 11, 2004
 Run Time: 7:19:55 AM
 Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.5	4.628e+07	3.592e-01	1.468e+00	7.051e-04	2.882e-03
0.6	1.216e+12	1.292e+04	4.718e+04	2.522e+01	9.208e+01
0.8	2.157e+09	3.751e+01	1.163e+02	7.134e-02	2.211e-01
1.0	2.998e+10	7.638e+02	2.119e+03	1.408e+00	3.906e+00
1.5	2.970e+10	1.509e+03	3.496e+03	2.539e+00	5.882e+00
2.0	1.050e+08	8.602e+00	1.801e+01	1.330e-02	2.786e-02
3.0	1.436e+01	2.259e-06	4.173e-06	3.065e-09	5.662e-09
TOTALS:	1.402e+12	1.525e+04	5.297e+04	2.926e+01	1.022e+02

Results - Dose Point # 5 - (0,231.775,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.681e+10	1.514e-188	9.755e-25	1.298e-189	8.367e-26
0.02	1.296e+08	3.346e-87	1.648e-26	1.159e-88	5.709e-28
0.03	7.971e+10	1.347e-26	6.520e-23	1.335e-28	6.462e-25
0.04	2.118e+10	6.211e-12	2.009e-10	2.747e-14	8.885e-13
0.05	6.155e+08	9.624e-08	4.904e-06	2.564e-10	1.306e-08
0.06	7.438e+08	5.076e-05	2.689e-03	1.008e-07	5.341e-06
0.08	1.878e+08	2.170e-03	7.752e-02	3.434e-06	1.227e-04
0.1	2.512e+09	2.203e-01	5.094e+00	3.370e-04	7.793e-03
0.15	7.230e+06	4.123e-03	4.853e-02	6.789e-06	7.992e-05
0.2	5.821e+08	7.093e-01	5.948e+00	1.252e-03	1.050e-02
0.3	8.776e+08	2.418e+00	1.417e+01	4.588e-03	2.687e-02
0.4	5.651e+08	2.611e+00	1.241e+01	5.087e-03	2.417e-02
0.5	4.628e+07	3.153e-01	1.291e+00	6.189e-04	2.534e-03
0.6	1.216e+12	1.134e+04	4.149e+04	2.214e+01	8.099e+01
0.8	2.157e+09	3.294e+01	1.023e+02	6.265e-02	1.946e-01
1.0	2.998e+10	6.710e+02	1.865e+03	1.237e+00	3.438e+00
1.5	2.970e+10	1.327e+03	3.079e+03	2.232e+00	5.180e+00
2.0	1.050e+08	7.566e+00	1.587e+01	1.170e-02	2.455e-02
3.0	1.436e+01	1.989e-06	3.680e-06	2.698e-09	4.993e-09
TOTALS:	1.402e+12	1.339e+04	4.659e+04	2.569e+01	8.990e+01

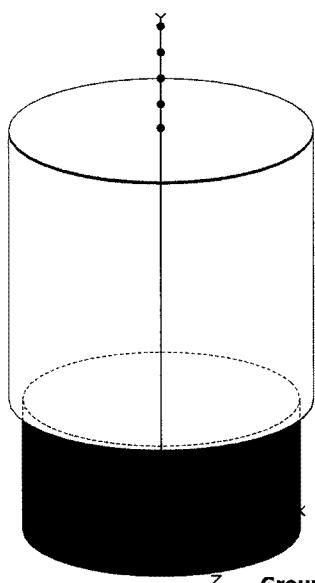
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEE

Page : 1
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 11, 2004
 Run Time: 7:35:39 AM
 Duration : 00:00:02

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: TAN V tank Process
Description: V-tank+ARA waste Decayed 8yr & 6yr 2940 gal 1880 gal top .5"
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions			
Height	152.4 cm	5 ft 0.0 in	
Radius	152.4 cm	5 ft 0.0 in	

Dose Points			
#	X	Y	Z
# 1	0 cm 0.0 in	470.5985 cm 15 ft 5.3 in	0 cm 0.0 in
# 2	0 cm 0.0 in	498.5385 cm 16 ft 4.3 in	0 cm 0.0 in
# 3	0 cm 0.0 in	529.0185 cm 17 ft 4.3 in	0 cm 0.0 in
# 4	0 cm 0.0 in	559.4985 cm 18 ft 4.3 in	0 cm 0.0 in
# 5	0 cm 0.0 in	589.9785 cm 19 ft 4.3 in	0 cm 0.0 in

Shields			
Shield Name	Dimension	Material	Density
Source	6.79e+05 in ³	V123 SLUDGE	1.02
Shield 1	123.4 in	Air	0.00122
Shield 2	.375 in	304L	8
Shield 3	.5 in	Lead	11.34
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bg/cm^3
Ac-225	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Ac-227	1.7700e-008	6.5490e+002	1.5917e-009	5.8894e-005
Ac-228	5.1800e-019	1.9166e-008	4.6583e-020	1.7236e-015
Ag-108	4.9600e-004	1.8352e+007	4.4604e-005	1.6504e+000
Ag-108m	5.3300e-003	1.9721e+008	4.7932e-004	1.7735e+001
Ag-110	3.5500e-008	1.3135e+003	3.1924e-009	1.1812e-004
Ag-110m	2.6700e-006	9.8790e+004	2.4011e-007	8.8840e-003
Am-241	5.5200e-002	2.0424e+009	4.9640e-003	1.8367e+002
Am-243	2.1600e-008	7.9920e+002	1.9424e-009	7.1871e-005
At-217	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Ba-137m	3.6500e+001	1.3505e+012	3.2824e+000	1.2145e+005
Bi-210	2.3300e-003	8.6210e+007	2.0953e-004	7.7527e+000
Bi-211	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Bi-212	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Bi-213	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Bi-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ce-144	4.8600e-005	1.7982e+006	4.3705e-006	1.6171e-001
Cm-242	8.4300e-010	3.1191e+001	7.5809e-011	2.8049e-006
Cm-243	1.0900e-002	4.0330e+008	9.8022e-004	3.6268e+001
Cm-244	9.7200e-003	3.5964e+008	8.7410e-004	3.2342e+001
Co-58	5.2800e-015	1.9536e-004	4.7482e-016	1.7568e-011
Co-60	7.4500e-001	2.7565e+010	6.6996e-002	2.4789e+003

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<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bg/cm^3</u>
Cs-134	8.5800e-004	3.1746e+007	7.7158e-005	2.8549e+000
Cs-137	3.8600e+001	1.4282e+012	3.4712e+000	1.2844e+005
Eu-152	7.3300e-002	2.7121e+009	6.5917e-003	2.4389e+002
Eu-154	9.9000e-002	3.6630e+009	8.9029e-003	3.2941e+002
Eu-155	6.7900e-003	2.5123e+008	6.1061e-004	2.2593e+001
Fe-55	1.3700e-008	5.0690e+002	1.2320e-009	4.5585e-005
Fr-221	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Fr-223	2.4400e-010	9.0280e+000	2.1942e-011	8.1187e-007
Gd-152	1.2600e-015	4.6620e-005	1.1331e-016	4.1924e-012
H-3	6.3900e-003	2.3643e+008	5.7464e-004	2.1262e+001
I-129	3.4400e-004	1.2728e+007	3.0935e-005	1.1446e+000
Mn-54	4.9300e-006	1.8241e+005	4.4335e-007	1.6404e-002
Nb-95	6.1000e-015	2.2570e-004	5.4856e-016	2.0297e-011
Nb-95m	2.3400e-017	8.6580e-007	2.1043e-018	7.7860e-014
Ni-63	5.2200e+000	1.9314e+011	4.6942e-001	1.7369e+004
Np-237	1.6800e-004	6.2160e+006	1.5108e-005	5.5899e-001
Np-239	2.1600e-008	7.9920e+002	1.9424e-009	7.1871e-005
Pa-231	1.5100e-007	5.5870e+003	1.3579e-008	5.0243e-004
Pa-233	1.6800e-004	6.2160e+006	1.5108e-005	5.5899e-001
Pa-234	8.6200e-007	3.1894e+004	7.7518e-008	2.8682e-003
Pa-234m	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Pb-209	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Pb-210	2.3400e-003	8.6580e+007	2.1043e-004	7.7860e+000
Pb-211	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Pb-212	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Pb-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Po-210	2.1900e-003	8.1030e+007	1.9694e-004	7.2869e+000
Po-211	4.6900e-011	1.7353e+000	4.2176e-012	1.5605e-007
Po-212	6.9400e-010	2.5678e+001	6.2410e-011	2.3092e-006
Po-213	2.0500e-005	7.5850e+005	1.8435e-006	6.8210e-002
Po-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Po-215	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Po-216	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Po-218	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Pr-144	4.8600e-005	1.7982e+006	4.3705e-006	1.6171e-001
Pr-144m	6.9500e-007	2.5715e+004	6.2500e-008	2.3125e-003
Pu-238	8.3400e-002	3.0858e+009	7.5000e-003	2.7750e+002
Pu-239	4.6300e-002	1.7131e+009	4.1637e-003	1.5406e+002
Pu-240	4.3200e-002	1.5984e+009	3.8849e-003	1.4374e+002
Ra-223	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Ra-224	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Ra-225	2.1100e-005	7.8070e+005	1.8975e-006	7.0207e-002
Ra-226	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ra-228	5.1800e-019	1.9166e-008	4.6583e-020	1.7236e-015
Rh-103m	9.6800e-023	3.5816e-012	8.7050e-024	3.2209e-019
Rh-106	2.6600e-004	9.8420e+006	2.3921e-005	8.8507e-001
Rn-219	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Rn-220	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Rn-222	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ru-103	9.7000e-023	3.5890e-012	8.7230e-024	3.2275e-019
Ru-106	2.6600e-004	9.8420e+006	2.3921e-005	8.8507e-001
Sb-125	3.5100e-003	1.2987e+008	3.1565e-004	1.1679e+001
Sr-90	6.8900e+001	2.5493e+012	6.1960e+000	2.2925e+005
Te-125m	8.5900e-004	3.1783e+007	7.7248e-005	2.8582e+000
Th-227	1.7100e-008	6.3270e+002	1.5378e-009	5.6897e-005
Th-228	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Th-229	2.1200e-005	7.8440e+005	1.9065e-006	7.0540e-002
Th-230	2.3200e-006	8.5840e+004	2.0863e-007	7.7194e-003
Th-231	8.9900e-004	3.3263e+007	8.0845e-005	2.9913e+000
Th-232	2.0200e-018	7.4740e-008	1.8165e-019	6.7212e-015

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Nuclide	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Th-234	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Tl-207	1.7100e-008	6.3270e+002	1.5378e-009	5.6897e-005
Tl-208	3.8900e-010	1.4393e+001	3.4982e-011	1.2943e-006
Tl-209	4.5200e-007	1.6724e+004	4.0647e-008	1.5040e-003
U-233	2.8200e-002	1.0434e+009	2.5360e-003	9.3831e+001
U-234	3.3000e-002	1.2210e+009	2.9676e-003	1.0980e+002
U-235	8.9900e-004	3.3263e+007	8.0845e-005	2.9913e+000
U-236	1.0200e-008	3.7740e+002	9.1727e-010	3.3939e-005
U-238	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Y-90	6.8900e+001	2.5493e+012	6.1960e+000	2.2925e+005
Zn-65	2.7500e-006	1.0175e+005	2.4730e-007	9.1502e-003
Zr-95	2.7600e-015	1.0212e-004	2.4820e-016	9.1835e-012

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (0,185.275,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		No Buildup	With Buildup	No Buildup	With Buildup
0.015	1.681e+10	0.000e+00	1.625e-24	0.000e+00	1.394e-25
0.02	1.296e+08	0.000e+00	2.745e-26	0.000e+00	9.509e-28
0.03	7.971e+10	7.711e-209	1.086e-22	7.642e-211	1.076e-24
0.04	2.118e+10	4.244e-97	2.583e-22	1.877e-99	1.142e-24
0.05	6.155e+08	7.569e-55	4.983e-23	2.016e-57	1.328e-25
0.06	7.438e+08	4.518e-34	3.052e-22	8.975e-37	6.061e-25
0.08	1.878e+08	5.353e-17	1.004e-13	8.471e-20	1.588e-16
0.1	2.512e+09	1.741e-35	1.527e-20	2.663e-38	2.336e-23
0.15	7.230e+06	2.405e-15	7.080e-12	3.960e-18	1.166e-14
0.2	5.821e+08	8.573e-07	3.484e-04	1.513e-09	6.148e-07
0.3	8.776e+08	1.421e-02	7.228e-01	2.696e-05	1.371e-03
0.4	5.651e+08	1.708e-01	3.304e+00	3.328e-04	6.437e-03
0.5	4.628e+07	5.563e-02	6.333e-01	1.092e-04	1.243e-03
0.6	1.216e+12	3.321e+03	2.719e+04	6.483e+00	5.308e+01
0.8	2.157e+09	1.588e+01	8.783e+01	3.020e-02	1.671e-01
1.0	2.998e+10	4.132e+02	1.807e+03	7.616e-01	3.332e+00
1.5	2.970e+10	1.060e+03	3.377e+03	1.784e+00	5.682e+00
2.0	1.050e+08	6.574e+00	1.798e+01	1.017e-02	2.781e-02
3.0	1.436e+01	1.812e-06	4.187e-06	2.459e-09	5.681e-09
TOTALS:	1.402e+12	4.817e+03	3.249e+04	9.069e+00	6.229e+01

Results - Dose Point # 2 - (0,196.275,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		No Buildup	With Buildup	No Buildup	With Buildup
0.015	1.681e+10	0.000e+00	1.427e-24	0.000e+00	1.224e-25
0.02	1.296e+08	0.000e+00	2.411e-26	0.000e+00	8.351e-28
0.03	7.971e+10	7.626e-209	9.537e-23	7.558e-211	9.452e-25
0.04	2.118e+10	4.210e-97	2.268e-22	1.862e-99	1.003e-24
0.05	6.155e+08	7.518e-55	4.376e-23	2.003e-57	1.166e-25
0.06	7.438e+08	4.487e-34	2.680e-22	8.913e-37	5.323e-25
0.08	1.878e+08	5.238e-17	9.794e-14	8.290e-20	1.550e-16

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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.1	2.512e+09	1.731e-35	1.341e-20	2.648e-38	2.051e-23
0.15	7.230e+06	2.335e-15	6.839e-12	3.844e-18	1.126e-14
0.2	5.821e+08	8.007e-07	3.225e-04	1.413e-09	5.692e-07
0.3	8.776e+08	1.276e-02	6.436e-01	2.421e-05	1.221e-03
0.4	5.651e+08	1.513e-01	2.907e+00	2.947e-04	5.665e-03
0.5	4.628e+07	4.897e-02	5.548e-01	9.613e-05	1.089e-03
0.6	1.216e+12	2.915e+03	2.377e+04	5.689e+00	4.640e+01
0.8	2.157e+09	1.389e+01	7.665e+01	2.642e-02	1.458e-01
1.0	2.998e+10	3.610e+02	1.576e+03	6.654e-01	2.906e+00
1.5	2.970e+10	9.253e+02	2.944e+03	1.557e+00	4.954e+00
2.0	1.050e+08	5.736e+00	1.568e+01	8.870e-03	2.425e-02
3.0	1.436e+01	1.582e-06	3.655e-06	2.146e-09	4.959e-09
TOTALS:	1.402e+12	4.221e+03	2.839e+04	7.947e+00	5.444e+01

Results - Dose Point # 3 - (0,208.275,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.681e+10	0.000e+00	1.243e-24	0.000e+00	1.066e-25
0.02	1.296e+08	0.000e+00	2.100e-26	0.000e+00	7.273e-28
0.03	7.971e+10	7.534e-209	8.306e-23	7.467e-211	8.232e-25
0.04	2.118e+10	4.174e-97	1.976e-22	1.846e-99	8.738e-25
0.05	6.155e+08	7.462e-55	3.812e-23	1.988e-57	1.015e-25
0.06	7.438e+08	4.450e-34	2.334e-22	8.838e-37	4.636e-25
0.08	1.878e+08	5.083e-17	9.473e-14	8.044e-20	1.499e-16
0.1	2.512e+09	1.719e-35	1.168e-20	2.629e-38	1.787e-23
0.15	7.230e+06	2.244e-15	6.538e-12	3.696e-18	1.077e-14
0.2	5.821e+08	7.396e-07	2.954e-04	1.305e-09	5.214e-07
0.3	8.776e+08	1.137e-02	5.691e-01	2.156e-05	1.080e-03
0.4	5.651e+08	1.331e-01	2.544e+00	2.593e-04	4.957e-03
0.5	4.628e+07	4.286e-02	4.836e-01	8.412e-05	9.493e-04
0.6	1.216e+12	2.544e+03	2.069e+04	4.965e+00	4.038e+01
0.8	2.157e+09	1.209e+01	6.661e+01	2.300e-02	1.267e-01
1.0	2.998e+10	3.139e+02	1.369e+03	5.787e-01	2.524e+00
1.5	2.970e+10	8.039e+02	2.557e+03	1.353e+00	4.302e+00
2.0	1.050e+08	4.984e+00	1.363e+01	7.707e-03	2.107e-02
3.0	1.436e+01	1.375e-06	3.178e-06	1.866e-09	4.311e-09
TOTALS:	1.402e+12	3.679e+03	2.470e+04	6.927e+00	4.736e+01

Results - Dose Point # 4 - (0,220.275,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.681e+10	0.000e+00	1.093e-24	0.000e+00	9.379e-26
0.02	1.296e+08	0.000e+00	1.848e-26	0.000e+00	6.400e-28
0.03	7.971e+10	7.444e-209	7.309e-23	7.377e-211	7.244e-25
0.04	2.118e+10	4.138e-97	1.738e-22	1.830e-99	7.689e-25
0.05	6.155e+08	7.406e-55	3.354e-23	1.973e-57	8.935e-26
0.06	7.438e+08	4.404e-34	2.054e-22	8.748e-37	4.080e-25
0.08	1.878e+08	4.902e-17	9.103e-14	7.757e-20	1.440e-16
0.1	2.512e+09	1.704e-35	1.028e-20	2.608e-38	1.572e-23
0.15	7.230e+06	2.144e-15	6.211e-12	3.530e-18	1.023e-14
0.2	5.821e+08	6.810e-07	2.701e-04	1.202e-09	4.766e-07
0.3	8.776e+08	1.015e-02	5.052e-01	1.925e-05	9.584e-04

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
 Run Date: November 11, 2004
 Run Time: 7:35:39 AM
 Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.4	5.651e+08	1.176e-01	2.240e+00	2.292e-04	4.364e-03
0.5	4.628e+07	3.773e-02	4.245e-01	7.405e-05	8.333e-04
0.6	1.216e+12	2.235e+03	1.813e+04	4.362e+00	3.540e+01
0.8	2.157e+09	1.060e+01	5.833e+01	2.017e-02	1.110e-01
1.0	2.998e+10	2.750e+02	1.199e+03	5.069e-01	2.210e+00
1.5	2.970e+10	7.039e+02	2.239e+03	1.184e+00	3.767e+00
2.0	1.050e+08	4.365e+00	1.194e+01	6.749e-03	1.846e-02
3.0	1.436e+01	1.205e-06	2.786e-06	1.635e-09	3.779e-09
TOTALS:	1.402e+12	3.229e+03	2.165e+04	6.080e+00	4.151e+01

Results - Dose Point # 5 - (0,232.275,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.681e+10	0.000e+00	9.708e-25	0.000e+00	8.327e-26
0.02	1.296e+08	0.000e+00	1.640e-26	0.000e+00	5.682e-28
0.03	7.971e+10	7.354e-209	6.489e-23	7.288e-211	6.431e-25
0.04	2.118e+10	4.103e-97	1.543e-22	1.814e-99	6.826e-25
0.05	6.155e+08	7.348e-55	2.978e-23	1.957e-57	7.932e-26
0.06	7.438e+08	4.349e-34	1.823e-22	8.639e-37	3.622e-25
0.08	1.878e+08	4.700e-17	8.698e-14	7.438e-20	1.376e-16
0.1	2.512e+09	1.687e-35	9.123e-21	2.581e-38	1.396e-23
0.15	7.230e+06	2.037e-15	5.871e-12	3.354e-18	9.668e-15
0.2	5.821e+08	6.260e-07	2.467e-04	1.105e-09	4.355e-07
0.3	8.776e+08	9.090e-03	4.505e-01	1.724e-05	8.545e-04
0.4	5.651e+08	1.045e-01	1.984e+00	2.036e-04	3.865e-03
0.5	4.628e+07	3.340e-02	3.751e-01	6.556e-05	7.363e-04
0.6	1.216e+12	1.975e+03	1.601e+04	3.855e+00	3.124e+01
0.8	2.157e+09	9.358e+00	5.145e+01	1.780e-02	9.787e-02
1.0	2.998e+10	2.426e+02	1.057e+03	4.471e-01	1.949e+00
1.5	2.970e+10	6.207e+02	1.975e+03	1.044e+00	3.323e+00
2.0	1.050e+08	3.850e+00	1.053e+01	5.953e-03	1.629e-02
3.0	1.436e+01	1.064e-06	2.460e-06	1.443e-09	3.338e-09
TOTALS:	1.402e+12	2.852e+03	1.910e+04	5.371e+00	3.664e+01

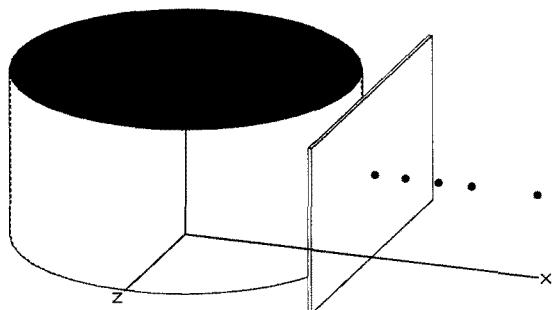
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
Run Date: November 1, 2004
Run Time: 3:29:30 PM
Duration : 00:00:33

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: TAN V tank Process
Description: V-tank+ARA waste Decayed 8yr & 6yr 2940 gal (1880 gal) Fe
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions			
Height	152.4 cm	5 ft 0.0 in	
Radius	152.4 cm	5 ft 0.0 in	

Dose Points			
# 1	X 174.3075 cm 5 ft 8.6 in	Y 76.25 cm 2 ft 6.0 in	Z 0 cm 0.0 in
# 2	202.2475 cm 6 ft 7.6 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in
# 3	232.7275 cm 7 ft 7.6 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in
# 4	263.2075 cm 8 ft 7.6 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in
# 5	324.1675 cm 10 ft 7.6 in	76.25 cm 2 ft 6.0 in	0 cm 0.0 in

Shields				
Shield Name	Dimension	Material	Density	
Source	6.79e+05 in ³	V123 SLUDGE	1.02	
Shield 1	.375 in	304L	8	
Transition	6.0 in	Air	0.00122	
Shield 3	1.25 in	Iron	7.86	
Air Gap		Air	0.00122	

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Ac-227	1.7700e-008	6.5490e+002	1.5917e-009	5.8894e-005
Ac-228	5.1800e-019	1.9166e-008	4.6583e-020	1.7236e-015
Ag-108	4.9600e-004	1.8352e+007	4.4604e-005	1.6504e+000
Ag-108m	5.3300e-003	1.9721e+008	4.7932e-004	1.7735e+001
Ag-110	3.5500e-008	1.3135e+003	3.1924e-009	1.1812e-004
Ag-110m	2.6700e-006	9.8790e+004	2.4011e-007	8.8840e-003
Am-241	5.5200e-002	2.0424e+009	4.9640e-003	1.8367e+002
Am-243	2.1600e-008	7.9920e+002	1.9424e-009	7.1871e-005
At-217	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Ba-137m	3.6500e+001	1.3505e+012	3.2824e+000	1.2145e+005
Bi-210	2.3300e-003	8.6210e+007	2.0953e-004	7.7527e+000
Bi-211	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Bi-212	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Bi-213	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Bi-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ce-144	4.8600e-005	1.7982e+006	4.3705e-006	1.6171e-001
Cm-242	8.4300e-010	3.1191e+001	7.5809e-011	2.8049e-006
Cm-243	1.0900e-002	4.0330e+008	9.8022e-004	3.6268e+001
Cm-244	9.7200e-003	3.5964e+008	8.7410e-004	3.2342e+001
Co-58	5.2800e-015	1.9536e-004	4.7482e-016	1.7568e-011
Co-60	7.4500e-001	2.7565e+010	6.6996e-002	2.4789e+003

ENGINEERING DESIGN FILE

age : 2
IOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
Run Date: November 1, 2004
Run Time: 3:29:30 PM
Duration : 00:00:33

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Cs-134	8.5800e-004	3.1746e+007	7.7158e-005	2.8549e+000
Cs-137	3.8600e+001	1.4282e+012	3.4712e+000	1.2844e+005
Eu-152	7.3300e-002	2.7121e+009	6.5917e-003	2.4389e+002
Eu-154	9.9000e-002	3.6630e+009	8.9029e-003	3.2941e+002
Eu-155	6.7900e-003	2.5123e+008	6.1061e-004	2.2593e+001
Fe-55	1.3700e-008	5.0690e+002	1.2320e-009	4.5585e-005
Fr-221	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Fr-223	2.4400e-010	9.0280e+000	2.1942e-011	8.1187e-007
Gd-152	1.2600e-015	4.6620e-005	1.1331e-016	4.1924e-012
H-3	6.3900e-003	2.3643e+008	5.7464e-004	2.1262e+001
I-129	3.4400e-004	1.2728e+007	3.0935e-005	1.1446e+000
Mn-54	4.9300e-006	1.8241e+005	4.4335e-007	1.6404e-002
Nb-95	6.1000e-015	2.2570e-004	5.4856e-016	2.0297e-011
Nb-95m	2.3400e-017	8.6580e-007	2.1043e-018	7.7860e-014
Ni-63	5.2200e+000	1.9314e+011	4.6942e-001	1.7369e+004
Np-237	1.6800e-004	6.2160e+006	1.5108e-005	5.5899e-001
Np-239	2.1600e-008	7.9920e+002	1.9424e-009	7.1871e-005
Pa-231	1.5100e-007	5.5870e+003	1.3579e-008	5.0243e-004
Pa-233	1.6800e-004	6.2160e+006	1.5108e-005	5.5899e-001
Pa-234	8.6200e-007	3.1894e+004	7.7518e-008	2.8682e-003
Pa-234m	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Pb-209	2.0900e-005	7.7330e+005	1.8795e-006	6.9541e-002
Pb-210	2.3400e-003	8.6580e+007	2.1043e-004	7.7860e+000
Pb-211	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Pb-212	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Pb-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Po-210	2.1900e-003	8.1030e+007	1.9694e-004	7.2869e+000
Po-211	4.6900e-011	1.7353e+000	4.2176e-012	1.5605e-007
Po-212	6.9400e-010	2.5678e+001	6.2410e-011	2.3092e-006
Po-213	2.0500e-005	7.5850e+005	1.8435e-006	6.8210e-002
Po-214	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Po-215	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Po-216	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Po-218	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Pr-144	4.8600e-005	1.7982e+006	4.3705e-006	1.6171e-001
Pr-144m	6.9500e-007	2.5715e+004	6.2500e-008	2.3125e-003
Pu-238	8.3400e-002	3.0858e+009	7.5000e-003	2.7750e+002
Pu-239	4.6300e-002	1.7131e+009	4.1637e-003	1.5406e+002
Pu-240	4.3200e-002	1.5984e+009	3.8849e-003	1.4374e+002
Ra-223	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Ra-224	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Ra-225	2.1100e-005	7.8070e+005	1.8975e-006	7.0207e-002
Ra-226	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ra-228	5.1800e-019	1.9166e-008	4.6583e-020	1.7236e-015
Rh-103m	9.6800e-023	3.5816e-012	8.7050e-024	3.2209e-019
Rh-106	2.6600e-004	9.8420e+006	2.3921e-005	8.8507e-001
Rn-219	1.7200e-008	6.3640e+002	1.5468e-009	5.7230e-005
Rn-220	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Rn-222	1.0600e-002	3.9220e+008	9.5324e-004	3.5270e+001
Ru-103	9.7000e-023	3.5890e-012	8.7230e-024	3.2275e-019
Ru-106	2.6600e-004	9.8420e+006	2.3921e-005	8.8507e-001
Sb-125	3.5100e-003	1.2987e+008	3.1565e-004	1.1679e+001
Sr-90	6.8900e+001	2.5493e+012	6.1960e+000	2.2925e+005
Te-125m	8.5900e-004	3.1783e+007	7.7248e-005	2.8582e+000
Th-227	1.7100e-008	6.3270e+002	1.5378e-009	5.6897e-005
Th-228	1.0800e-009	3.9960e+001	9.7122e-011	3.5935e-006
Th-229	2.1200e-005	7.8440e+005	1.9065e-006	7.0540e-002
Th-230	2.3200e-006	8.5840e+004	2.0863e-007	7.7194e-003
Th-231	8.9900e-004	3.3263e+007	8.0845e-005	2.9913e+000
Th-232	2.0200e-018	7.4740e-008	1.8165e-019	6.7212e-015

ENGINEERING DESIGN FILE

Page : 3
DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
Run Date: November 1, 2004
Run Time: 3:29:30 PM
Duration : 00:00:33

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Th-234	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Tl-207	1.7100e-008	6.3270e+002	1.5378e-009	5.6897e-005
Tl-208	3.8900e-010	1.4393e+001	3.4982e-011	1.2943e-006
Tl-209	4.5200e-007	1.6724e+004	4.0647e-008	1.5040e-003
U-233	2.8200e-002	1.0434e+009	2.5360e-003	9.3831e+001
U-234	3.3000e-002	1.2210e+009	2.9676e-003	1.0980e+002
U-235	8.9900e-004	3.3263e+007	8.0845e-005	2.9913e+000
U-236	1.0200e-008	3.7740e+002	9.1727e-010	3.3939e-005
U-238	5.3900e-004	1.9943e+007	4.8471e-005	1.7934e+000
Y-90	6.8900e+001	2.5493e+012	6.1960e+000	2.2925e+005
Zn-65	2.7500e-006	1.0175e+005	2.4730e-007	9.1502e-003
Zr-95	2.7600e-015	1.0212e-004	2.4820e-016	9.1835e-012

Buildup
The material reference is : Shield 3

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (68.625,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	0.000e+00	3.242e-29	0.000e+00	2.780e-30
0.02	1.296e+08	0.000e+00	1.033e-25	0.000e+00	3.578e-27
0.03	7.971e+10	1.878e-113	8.723e-23	1.861e-115	8.645e-25
0.04	2.118e+10	4.258e-50	3.544e-23	1.883e-52	1.567e-25
0.05	6.155e+08	4.270e-28	1.473e-24	1.138e-30	3.924e-27
0.06	7.438e+08	2.036e-17	3.367e-17	4.045e-20	6.688e-20
0.08	1.878e+08	2.526e-09	5.586e-09	3.998e-12	8.840e-12
0.1	2.512e+09	6.599e-05	1.889e-04	1.010e-07	2.889e-07
0.15	7.230e+06	1.080e-04	4.749e-04	1.779e-07	7.821e-07
0.2	5.821e+08	6.930e-02	4.054e-01	1.223e-04	7.154e-04
0.3	8.776e+08	6.255e-01	4.347e+00	1.187e-03	8.246e-03
0.4	5.651e+08	1.062e+00	7.457e+00	2.069e-03	1.453e-02
0.5	4.628e+07	1.721e-01	1.144e+00	3.378e-04	2.246e-03
0.6	1.216e+12	7.704e+03	4.767e+04	1.504e+01	9.304e+01
0.8	2.157e+09	3.085e+01	1.651e+02	5.867e-02	3.139e-01
1.0	2.998e+10	7.936e+02	3.734e+03	1.463e+00	6.882e+00
1.5	2.970e+10	2.299e+03	8.519e+03	3.868e+00	1.433e+01
2.0	1.050e+08	1.633e+01	5.244e+01	2.526e-02	8.109e-02
3.0	1.436e+01	5.429e-06	1.443e-05	7.366e-09	1.958e-08
TOTALS:	1.385e+12	1.085e+04	6.015e+04	2.045e+01	1.147e+02

Results - Dose Point # 2 - (79.625,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	0.000e+00	2.154e-29	0.000e+00	1.847e-30
0.02	1.296e+08	0.000e+00	6.864e-26	0.000e+00	2.378e-27
0.03	7.971e+10	4.962e-113	5.796e-23	4.918e-115	5.744e-25
0.04	2.118e+10	4.313e-50	2.355e-23	1.908e-52	1.041e-25
0.05	6.155e+08	3.237e-28	9.787e-25	8.623e-31	2.607e-27
0.06	7.438e+08	1.619e-17	2.679e-17	3.216e-20	5.322e-20
0.08	1.878e+08	2.367e-09	5.244e-09	3.747e-12	8.299e-12

ENGINEERING DESIGN FILE

Page : 4

DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A

Run Date: November 1, 2004

Run Time: 3:29:30 PM

Duration : 00:00:33

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.1	2.512e+09	6.327e-05	1.811e-04	9.680e-08	2.770e-07
0.15	7.230e+06	1.010e-04	4.423e-04	1.664e-07	7.284e-07
0.2	5.821e+08	6.384e-02	3.703e-01	1.127e-04	6.535e-04
0.3	8.776e+08	5.661e-01	3.869e+00	1.074e-03	7.338e-03
0.4	5.651e+08	9.492e-01	6.506e+00	1.849e-03	1.268e-02
0.5	4.628e+07	1.523e-01	9.826e-01	2.989e-04	1.929e-03
0.6	1.216e+12	6.755e+03	4.040e+04	1.319e+01	7.885e+01
0.8	2.157e+09	2.661e+01	1.369e+02	5.061e-02	2.603e-01
1.0	2.998e+10	6.745e+02	3.042e+03	1.243e+00	5.607e+00
1.5	2.970e+10	1.896e+03	6.714e+03	3.190e+00	1.130e+01
2.0	1.050e+08	1.318e+01	4.045e+01	2.039e-02	6.255e-02
3.0	1.436e+01	4.263e-06	1.087e-05	5.784e-09	1.474e-08
TOTALS:	1.385e+12	9.367e+03	5.034e+04	1.769e+01	9.610e+01

Results - Dose Point # 3 - (91.625,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	0.000e+00	1.515e-29	0.000e+00	1.300e-30
0.02	1.296e+08	0.000e+00	4.829e-26	0.000e+00	1.673e-27
0.03	7.971e+10	4.157e-113	4.077e-23	4.120e-115	4.041e-25
0.04	2.118e+10	3.543e-50	1.656e-23	1.567e-52	7.326e-26
0.05	6.155e+08	3.079e-28	6.885e-25	8.202e-31	1.834e-27
0.06	7.438e+08	1.565e-17	2.589e-17	3.108e-20	5.142e-20
0.08	1.878e+08	2.205e-09	4.882e-09	3.489e-12	7.726e-12
0.1	2.512e+09	5.836e-05	1.669e-04	8.928e-08	2.554e-07
0.15	7.230e+06	9.013e-05	3.919e-04	1.484e-07	6.454e-07
0.2	5.821e+08	5.543e-02	3.165e-01	9.783e-05	5.587e-04
0.3	8.776e+08	4.767e-01	3.170e+00	9.042e-04	6.014e-03
0.4	5.651e+08	7.846e-01	5.202e+00	1.529e-03	1.014e-02
0.5	4.628e+07	1.242e-01	7.726e-01	2.437e-04	1.517e-03
0.6	1.216e+12	5.447e+03	3.138e+04	1.063e+01	6.125e+01
0.8	2.157e+09	2.109e+01	1.045e+02	4.011e-02	1.987e-01
1.0	2.998e+10	5.273e+02	2.294e+03	9.720e-01	4.228e+00
1.5	2.970e+10	1.448e+03	4.964e+03	2.436e+00	8.352e+00
2.0	1.050e+08	9.922e+00	2.959e+01	1.534e-02	4.575e-02
3.0	1.436e+01	3.158e-06	7.868e-06	4.285e-09	1.067e-08
TOTALS:	1.385e+12	7.455e+03	3.878e+04	1.410e+01	7.410e+01

Results - Dose Point # 4 - (103.625,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	0.000e+00	1.132e-29	0.000e+00	9.708e-31
0.02	1.296e+08	0.000e+00	3.607e-26	0.000e+00	1.249e-27
0.03	7.971e+10	3.475e-113	3.046e-23	3.444e-115	3.019e-25
0.04	2.118e+10	3.383e-50	1.237e-23	1.496e-52	5.473e-26
0.05	6.155e+08	2.928e-28	5.143e-25	7.801e-31	1.370e-27
0.06	7.438e+08	1.459e-17	2.413e-17	2.897e-20	4.793e-20
0.08	1.878e+08	2.040e-09	4.517e-09	3.228e-12	7.147e-12
0.1	2.512e+09	5.275e-05	1.506e-04	8.070e-08	2.304e-07
0.15	7.230e+06	7.699e-05	3.320e-04	1.268e-07	5.468e-07
0.2	5.821e+08	4.600e-02	2.590e-01	8.119e-05	4.570e-04
0.3	8.776e+08	3.856e-01	2.514e+00	7.314e-04	4.769e-03

ENGINEERING DESIGN FILE

Page : 5
DOS File : VTANK Consolidation tank 2940 gal decayed 8yr & 6yr plus A
Run Date: November 1, 2004
Run Time: 3:29:30 PM
Duration : 00:00:33

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.4	5.651e+08	6.263e-01	4.062e+00	1.220e-03	7.915e-03
0.5	4.628e+07	9.825e-02	5.976e-01	1.928e-04	1.173e-03
0.6	1.216e+12	4.281e+03	2.412e+04	8.355e+00	4.707e+01
0.8	2.157e+09	1.640e+01	7.955e+01	3.119e-02	1.513e-01
1.0	2.998e+10	4.070e+02	1.736e+03	7.503e-01	3.200e+00
1.5	2.970e+10	1.104e+03	3.722e+03	1.857e+00	5.263e+00
2.0	1.050e+08	7.510e+00	2.208e+01	1.161e-02	3.415e-02
3.0	1.436e+01	2.374e-06	5.851e-06	3.221e-09	7.938e-09
TOTALS:	1.385e+12	5.816e+03	2.968e+04	1.101e+01	5.673e+01

Results - Dose Point # 5 - (127.625,3.00e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.393e+04	0.000e+00	7.074e-30	0.000e+00	6.067e-31
0.02	1.296e+08	0.000e+00	2.254e-26	0.000e+00	7.809e-28
0.03	7.971e+10	2.980e-113	1.904e-23	2.953e-115	1.887e-25
0.04	2.118e+10	3.039e-50	7.733e-24	1.344e-52	3.420e-26
0.05	6.155e+08	2.552e-28	3.214e-25	6.798e-31	8.563e-28
0.06	7.438e+08	1.263e-17	2.089e-17	2.509e-20	4.150e-20
0.08	1.878e+08	1.665e-09	3.682e-09	2.635e-12	5.826e-12
0.1	2.512e+09	4.019e-05	1.143e-04	6.149e-08	1.749e-07
0.15	7.230e+06	5.339e-05	2.278e-04	8.791e-08	3.751e-07
0.2	5.821e+08	3.079e-02	1.705e-01	5.434e-05	3.010e-04
0.3	8.776e+08	2.509e-01	1.602e+00	4.758e-04	3.040e-03
0.4	5.651e+08	4.019e-01	2.550e+00	7.832e-04	4.969e-03
0.5	4.628e+07	6.249e-02	3.719e-01	1.227e-04	7.299e-04
0.6	1.216e+12	2.705e+03	1.492e+04	5.279e+00	2.912e+01
0.8	2.157e+09	1.026e+01	4.883e+01	1.952e-02	9.288e-02
1.0	2.998e+10	2.530e+02	1.061e+03	4.663e-01	1.955e+00
1.5	2.970e+10	6.787e+02	2.260e+03	1.142e+00	3.802e+00
2.0	1.050e+08	4.595e+00	1.338e+01	7.106e-03	2.068e-02
3.0	1.436e+01	1.446e-06	3.541e-06	1.962e-09	4.805e-09
TOTALS:	1.385e+12	3.652e+03	1.830e+04	6.915e+00	3.500e+01

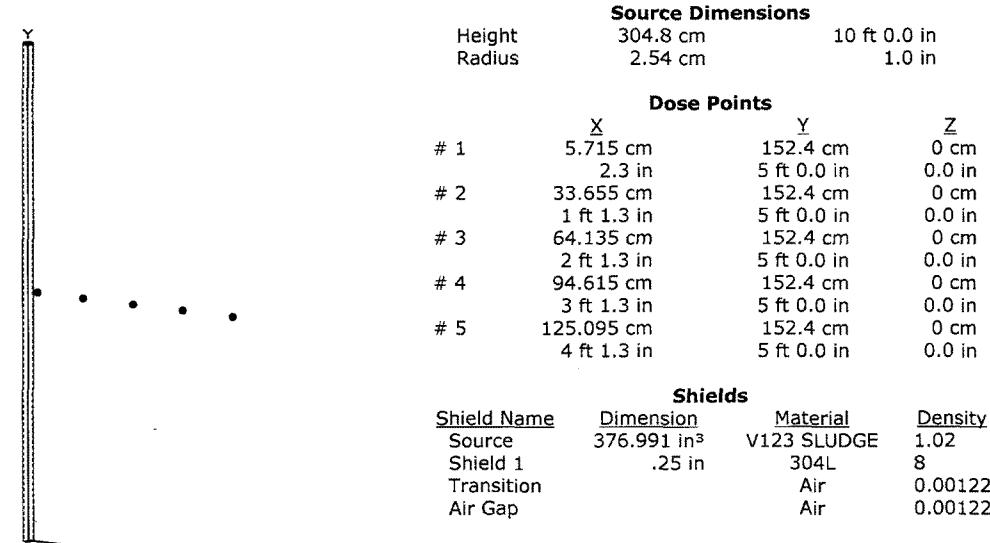
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
DOS File : VTANK ARA waste 2 in Stainless piping 2940 gal dilution (1
Run Date: November 1, 2004
Run Time: 5:30:35 PM
Duration : 00:00:31

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: TAN V tank Process
Description: Vtank+ARA waste Decayed 8yr&6yr 2940 gal (1880 gal) 10' pipe
Geometry: 7 - Cylinder Volume - Side Shields



Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	1.1611e-008	4.2961e+002	1.8795e-006	6.9541e-002
Ac-227	9.8333e-012	3.6383e-001	1.5917e-009	5.8894e-005
Ac-228	2.8778e-022	1.0648e-011	4.6583e-020	1.7236e-015
Ag-108	2.7556e-007	1.0196e+004	4.4604e-005	1.6504e+000
Ag-108m	2.9611e-006	1.0956e+005	4.7932e-004	1.7735e+001
Ag-110	1.9722e-011	7.2972e-001	3.1924e-009	1.1812e-004
Ag-110m	1.4833e-009	5.4883e+001	2.4011e-007	8.8840e-003
Am-241	3.0667e-005	1.1347e+006	4.9640e-003	1.8367e+002
Am-243	1.2000e-011	4.4400e-001	1.9424e-009	7.1871e-005
At-217	1.1611e-008	4.2961e+002	1.8795e-006	6.9541e-002
Ba-137m	2.0278e-002	7.5028e+008	3.2824e+000	1.2145e+005
Bi-210	1.2944e-006	4.7894e+004	2.0953e-004	7.7527e+000
Bi-211	9.5556e-012	3.5356e-001	1.5468e-009	5.7230e-005
Bi-212	6.0000e-013	2.2200e-002	9.7122e-011	3.5935e-006
Bi-213	1.1611e-008	4.2961e+002	1.8795e-006	6.9541e-002
Bi-214	5.8889e-006	2.1789e+005	9.5324e-004	3.5270e+001
Ce-144	2.7000e-008	9.9900e+002	4.3705e-006	1.6171e-001
Cm-242	4.6833e-013	1.7328e-002	7.5809e-011	2.8049e-006
Cm-243	6.0556e-006	2.2406e+005	9.8022e-004	3.6268e+001
Cm-244	5.4000e-006	1.9980e+005	8.7410e-004	3.2342e+001
Co-58	2.9333e-018	1.0853e-007	4.7482e-016	1.7568e-011
Co-60	4.1389e-004	1.5314e+007	6.6996e-002	2.4789e+003
Cs-134	4.7667e-007	1.7637e+004	7.7158e-005	2.8549e+000

Page : 2
DOS File : VTANK ARA waste 2 in Stainless piping 2940 gal dilution (1
Run Date: November 1, 2004
Run Time: 5:30:35 PM
Duration : 00:00:31

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Cs-137	2.1444e-002	7.9344e+008	3.4712e+000	1.2844e+005
Eu-152	4.0722e-005	1.5067e+006	6.5917e-003	2.4389e+002
Eu-154	5.5000e-005	2.0350e+006	8.9029e-003	3.2941e+002
Eu-155	3.7722e-006	1.3957e+005	6.1061e-004	2.2593e+001
Fe-55	7.6111e-012	2.8161e-001	1.2320e-009	4.5585e-005
Fr-221	1.1611e-008	4.2961e+002	1.8795e-006	6.9541e-002
Fr-223	1.3556e-013	5.0156e-003	2.1942e-011	8.1187e-007
Gd-152	7.0000e-019	2.5900e-008	1.1331e-016	4.1924e-012
H-3	3.5500e-006	1.3135e+005	5.7464e-004	2.1262e+001
I-129	1.9111e-007	7.0711e+003	3.0935e-005	1.1446e+000
Mn-54	2.7389e-009	1.0134e+002	4.4335e-007	1.6404e-002
Nb-95	3.3889e-018	1.2539e-007	5.4856e-016	2.0297e-011
Nb-95m	1.3000e-020	4.8100e-010	2.1043e-018	7.7860e-014
Ni-63	2.9000e-003	1.0730e+008	4.6942e-001	1.7369e+004
Np-237	9.3333e-008	3.4533e+003	1.5108e-005	5.5899e-001
Np-239	1.2000e-011	4.4400e-001	1.9424e-009	7.1871e-005
Pa-231	8.3889e-011	3.1039e+000	1.3579e-008	5.0243e-004
Pa-233	9.3333e-008	3.4533e+003	1.5108e-005	5.5899e-001
Pa-234	4.7889e-010	1.7719e+001	7.7518e-008	2.8682e-003
Pa-234m	2.9944e-007	1.1079e+004	4.8471e-005	1.7934e+000
Pb-209	1.1611e-008	4.2961e+002	1.8795e-006	6.9541e-002
Pb-210	1.3000e-006	4.8100e+004	2.1043e-004	7.7860e+000
Pb-211	9.5556e-012	3.5356e-001	1.5468e-009	5.7230e-005
Pb-212	6.0000e-013	2.2200e-002	9.7122e-011	3.5935e-006
Pb-214	5.8889e-006	2.1789e+005	9.5324e-004	3.5270e+001
Po-210	1.2167e-006	4.5017e+004	1.9694e-004	7.2869e+000
Po-211	2.6056e-014	9.6406e-004	4.2176e-012	1.5605e-007
Po-212	3.8556e-013	1.4266e-002	6.2410e-011	2.3092e-006
Po-213	1.1389e-008	4.2139e+002	1.8435e-006	6.8210e-002
Po-214	5.8889e-006	2.1789e+005	9.5324e-004	3.5270e+001
Po-215	9.5556e-012	3.5356e-001	1.5468e-009	5.7230e-005
Po-216	6.0000e-013	2.2200e-002	9.7122e-011	3.5935e-006
Po-218	5.8889e-006	2.1789e+005	9.5324e-004	3.5270e+001
Pr-144	2.7000e-008	9.9900e+002	4.3705e-006	1.6171e-001
Pr-144m	3.8611e-010	1.4286e+001	6.2500e-008	2.3125e-003
Pu-238	4.6333e-005	1.7143e+006	7.5000e-003	2.7750e+002
Pu-239	2.5722e-005	9.5172e+005	4.1637e-003	1.5406e+002
Pu-240	2.4000e-005	8.8800e+005	3.8849e-003	1.4374e+002
Ra-223	9.5556e-012	3.5356e-001	1.5468e-009	5.7230e-005
Ra-224	6.0000e-013	2.2200e-002	9.7122e-011	3.5935e-006
Ra-225	1.1722e-008	4.3372e+002	1.8975e-006	7.0207e-002
Ra-226	5.8889e-006	2.1789e+005	9.5324e-004	3.5270e+001
Ra-228	2.8778e-022	1.0648e-011	4.6583e-020	1.7236e-015
Rh-103m	5.3778e-026	1.9898e-015	8.7050e-024	3.2209e-019
Rh-106	1.4778e-007	5.4678e+003	2.3921e-005	8.8507e-001
Rn-219	9.5556e-012	3.5356e-001	1.5468e-009	5.7230e-005
Rn-220	6.0000e-013	2.2200e-002	9.7122e-011	3.5935e-006
Rn-222	5.8889e-006	2.1789e+005	9.5324e-004	3.5270e+001
Ru-103	5.3889e-026	1.9939e-015	8.7230e-024	3.2275e-019
Ru-106	1.4778e-007	5.4678e+003	2.3921e-005	8.8507e-001
Sb-125	1.9500e-006	7.2150e+004	3.1565e-004	1.1679e+001
Sr-90	3.8278e-002	1.4163e+009	6.1960e+000	2.2925e+005
Te-125m	4.7722e-007	1.7657e+004	7.7248e-005	2.8582e+000
Th-227	9.5000e-012	3.5150e-001	1.5378e-009	5.6897e-005
Th-228	6.0000e-013	2.2200e-002	9.7122e-011	3.5935e-006
Th-229	1.1778e-008	4.3578e+002	1.9065e-006	7.0540e-002
Th-230	1.2889e-009	4.7689e+001	2.0863e-007	7.7194e-003
Th-231	4.9944e-007	1.8479e+004	8.0845e-005	2.9913e+000
Th-232	1.1222e-021	4.1522e-011	1.8165e-019	6.7212e-015
Th-234	2.9944e-007	1.1079e+004	4.8471e-005	1.7934e+000

ENGINEERING DESIGN FILE

Page : 3
 DOS File : VTANK ARA waste 2 in Stainless piping 2940 gal dilution (1
 Run Date: November 1, 2004
 Run Time: 5:30:35 PM
 Duration : 00:00:31

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
TI-207	9.5000e-012	3.5150e-001	1.5378e-009	5.6897e-005
TI-208	2.1611e-013	7.9961e-003	3.4982e-011	1.2943e-006
TI-209	2.5111e-010	9.2911e+000	4.0647e-008	1.5040e-003
U-233	1.5667e-005	5.7967e+005	2.5360e-003	9.3831e+001
U-234	1.8333e-005	6.7833e+005	2.9676e-003	1.0980e+002
U-235	4.9944e-007	1.8479e+004	8.0845e-005	2.9913e+000
U-236	5.6667e-012	2.0967e-001	9.1727e-010	3.3939e-005
U-238	2.9944e-007	1.1079e+004	4.8471e-005	1.7934e+000
Y-90	3.8278e-002	1.4163e+009	6.1960e+000	2.2925e+005
Zn-65	1.5278e-009	5.6528e+001	2.4730e-007	9.1502e-003
Zr-95	1.5333e-018	5.6733e-008	2.4820e-016	9.1835e-012

Buildup
The material reference is : Shield 1

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (2.25,60,0) in

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec	MeV/cm ² /sec	mR/hr	mR/hr
0.015	3.552e+01	2.125e-143	6.848e-31	1.823e-144	5.873e-32
0.02	7.201e+04	2.821e-64	2.166e-27	9.772e-66	7.501e-29
0.03	4.428e+07	5.467e-19	5.984e-19	5.418e-21	5.931e-21
0.04	1.177e+07	2.404e-08	2.835e-08	1.063e-10	1.254e-10
0.05	3.420e+05	1.147e-05	1.472e-05	3.056e-08	3.922e-08
0.06	4.132e+05	1.234e-03	1.712e-03	2.452e-06	3.400e-06
0.08	1.043e+05	1.454e-02	2.283e-02	2.300e-05	3.613e-05
0.1	1.395e+06	9.365e-01	1.615e+00	1.433e-03	2.471e-03
0.15	4.017e+03	1.240e-02	2.462e-02	2.042e-05	4.054e-05
0.2	3.234e+05	1.891e+00	3.966e+00	3.337e-03	7.000e-03
0.3	4.876e+05	5.653e+00	1.174e+01	1.072e-02	2.227e-02
0.4	3.139e+05	5.579e+00	1.107e+01	1.087e-02	2.157e-02
0.5	2.571e+04	6.273e-01	1.182e+00	1.231e-03	2.321e-03
0.6	6.756e+08	2.124e+04	3.818e+04	4.145e+01	7.453e+01
0.8	1.198e+06	5.582e+01	9.299e+01	1.062e-01	1.769e-01
1.0	1.665e+07	1.048e+03	1.649e+03	1.931e+00	3.040e+00
1.5	1.650e+07	1.770e+03	2.535e+03	2.979e+00	4.264e+00
2.0	5.832e+04	9.005e+00	1.225e+01	1.392e-02	1.894e-02
3.0	7.980e-03	2.013e-06	2.582e-06	2.731e-09	3.503e-09
TOTALS:	7.695e+08	2.414e+04	4.250e+04	4.651e+01	8.209e+01

Results - Dose Point # 2 - (13.25,60,0) in

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec	MeV/cm ² /sec	mR/hr	mR/hr
0.015	3.552e+01	3.035e-132	9.909e-32	2.603e-133	8.499e-33
0.02	7.201e+04	2.572e-60	3.134e-28	8.910e-62	1.085e-29
0.03	4.428e+07	8.326e-19	9.112e-19	8.252e-21	9.031e-21
0.04	1.177e+07	6.106e-09	7.184e-09	2.700e-11	3.177e-11
0.05	3.420e+05	1.869e-06	2.392e-06	4.978e-09	6.371e-09
0.06	4.132e+05	1.821e-04	2.520e-04	3.618e-07	5.005e-07
0.08	1.043e+05	2.170e-03	3.421e-03	3.433e-06	5.413e-06
0.1	1.395e+06	1.441e-01	2.506e-01	2.205e-04	3.834e-04

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK ARA waste 2 in Stainless piping 2940 gal dilution (1
 Run Date: November 1, 2004
 Run Time: 5:30:35 PM
 Duration : 00:00:31

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.15	4.017e+03	1.963e-03	3.938e-03	3.233e-06	6.486e-06
0.2	3.234e+05	3.016e-01	6.400e-01	5.324e-04	1.130e-03
0.3	4.876e+05	9.060e-01	1.897e+00	1.719e-03	3.599e-03
0.4	3.139e+05	8.957e-01	1.786e+00	1.745e-03	3.479e-03
0.5	2.571e+04	1.008e-01	1.902e-01	1.978e-04	3.734e-04
0.6	6.756e+08	3.414e+03	6.129e+03	6.663e+00	1.196e+01
0.8	1.198e+06	8.972e+00	1.488e+01	1.706e-02	2.829e-02
1.0	1.665e+07	1.683e+02	2.631e+02	3.102e-01	4.850e-01
1.5	1.650e+07	2.837e+02	4.022e+02	4.773e-01	6.768e-01
2.0	5.832e+04	1.439e+00	1.936e+00	2.226e-03	2.994e-03
3.0	7.980e-03	3.205e-07	4.057e-07	4.348e-10	5.504e-10
TOTALS:	7.695e+08	3.878e+03	6.816e+03	7.474e+00	1.317e+01

Results - Dose Point # 3 - (25,25,60,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	3.552e+01	1.212e-132	4.502e-32	1.039e-133	3.861e-33
0.02	7.201e+04	1.188e-60	1.424e-28	4.116e-62	4.932e-30
0.03	4.428e+07	4.417e-19	4.834e-19	4.378e-21	4.791e-21
0.04	1.177e+07	3.170e-09	3.730e-09	1.402e-11	1.650e-11
0.05	3.420e+05	9.723e-07	1.245e-06	2.590e-09	3.315e-09
0.06	4.132e+05	9.488e-05	1.313e-04	1.885e-07	2.607e-07
0.08	1.043e+05	1.130e-03	1.782e-03	1.789e-06	2.821e-06
0.1	1.395e+06	7.494e-02	1.303e-01	1.147e-04	1.993e-04
0.15	4.017e+03	1.011e-03	2.018e-03	1.665e-06	3.324e-06
0.2	3.234e+05	1.541e-01	3.234e-01	2.720e-04	5.707e-04
0.3	4.876e+05	4.588e-01	9.411e-01	8.702e-04	1.785e-03
0.4	3.139e+05	4.509e-01	8.762e-01	8.786e-04	1.707e-03
0.5	2.571e+04	5.050e-02	9.268e-02	9.913e-05	1.819e-04
0.6	6.756e+08	1.704e+03	2.971e+03	3.326e+00	5.799e+00
0.8	1.198e+06	4.450e+00	7.158e+00	8.464e-03	1.362e-02
1.0	1.665e+07	8.303e+01	1.260e+02	1.531e-01	2.323e-01
1.5	1.650e+07	1.386e+02	1.912e+02	2.332e-01	3.218e-01
2.0	5.832e+04	6.988e-01	9.163e-01	1.081e-03	1.417e-03
3.0	7.980e-03	1.544e-07	1.911e-07	2.095e-10	2.593e-10
TOTALS:	7.695e+08	1.932e+03	3.299e+03	3.724e+00	6.372e+00

Results - Dose Point # 4 - (37.25,60,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	3.552e+01	7.827e-133	2.642e-32	6.714e-134	2.266e-33
0.02	7.201e+04	7.972e-61	8.355e-29	2.761e-62	2.894e-30
0.03	4.428e+07	2.956e-19	3.235e-19	2.929e-21	3.206e-21
0.04	1.177e+07	2.130e-09	2.506e-09	9.420e-12	1.108e-11
0.05	3.420e+05	6.540e-07	8.372e-07	1.742e-09	2.230e-09
0.06	4.132e+05	6.384e-05	8.833e-05	1.268e-07	1.754e-07
0.08	1.043e+05	7.568e-04	1.193e-03	1.198e-06	1.888e-06
0.1	1.395e+06	4.961e-02	8.602e-02	7.590e-05	1.316e-04
0.15	4.017e+03	6.532e-04	1.291e-03	1.076e-06	2.125e-06
0.2	3.234e+05	9.838e-02	2.030e-01	1.736e-04	3.583e-04
0.3	4.876e+05	2.895e-01	5.802e-01	5.491e-04	1.101e-03
0.4	3.139e+05	2.827e-01	5.355e-01	5.508e-04	1.043e-03

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK ARA waste 2 in Stainless piping 2940 gal dilution (1
 Run Date: November 1, 2004
 Run Time: 5:30:35 PM
 Duration : 00:00:31

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.5	2.571e+04	3.152e-02	5.634e-02	6.187e-05	1.106e-04
0.6	6.756e+08	1.060e+03	1.800e+03	2.069e+00	3.514e+00
0.8	1.198e+06	2.752e+00	4.320e+00	5.235e-03	8.216e-03
1.0	1.665e+07	5.114e+01	7.587e+01	9.427e-02	1.399e-01
1.5	1.650e+07	8.476e+01	1.147e+02	1.426e-01	1.930e-01
2.0	5.832e+04	4.254e-01	5.483e-01	6.579e-04	8.480e-04
3.0	7.980e-03	9.353e-08	1.141e-07	1.269e-10	1.548e-10
TOTALS:	7.695e+08	1.200e+03	1.997e+03	2.313e+00	3.859e+00

Results - Dose Point # 5 - (49.25,60,0) in					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	3.552e+01	5.648e-133	1.739e-32	4.845e-134	1.491e-33
0.02	7.201e+04	5.851e-61	5.499e-29	2.027e-62	1.905e-30
0.03	4.428e+07	2.209e-19	2.418e-19	2.189e-21	2.396e-21
0.04	1.177e+07	1.597e-09	1.879e-09	7.063e-12	8.311e-12
0.05	3.420e+05	4.908e-07	6.283e-07	1.307e-09	1.674e-09
0.06	4.132e+05	4.780e-05	6.614e-05	9.494e-08	1.314e-07
0.08	1.043e+05	5.573e-04	8.773e-04	8.820e-07	1.388e-06
0.1	1.395e+06	3.584e-02	6.188e-02	5.483e-05	9.467e-05
0.15	4.017e+03	4.593e-04	8.985e-04	7.563e-07	1.480e-06
0.2	3.234e+05	6.842e-02	1.392e-01	1.208e-04	2.457e-04
0.3	4.876e+05	1.995e-01	3.927e-01	3.784e-04	7.449e-04
0.4	3.139e+05	1.939e-01	3.604e-01	3.778e-04	7.022e-04
0.5	2.571e+04	2.155e-02	3.780e-02	4.230e-05	7.421e-05
0.6	6.756e+08	7.227e+02	1.206e+03	1.411e+00	2.353e+00
0.8	1.198e+06	1.870e+00	2.887e+00	3.557e-03	5.490e-03
1.0	1.665e+07	3.465e+01	5.064e+01	6.387e-02	9.334e-02
1.5	1.650e+07	5.715e+01	7.640e+01	9.616e-02	1.285e-01
2.0	5.832e+04	2.861e-01	3.647e-01	4.423e-04	5.640e-04
3.0	7.980e-03	6.270e-08	7.576e-08	8.506e-11	1.028e-10
TOTALS:	7.695e+08	8.172e+02	1.337e+03	1.576e+00	2.583e+00

ENGINEERING DESIGN FILE

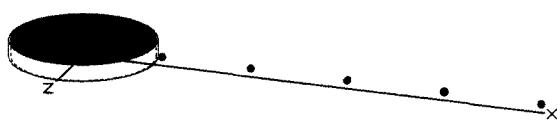
4

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK Pump housing 2 gal decayed 8yr & 6yr plus ARA waste
 Run Date: December 1, 2004
 Run Time: 4:50:14 PM
 Duration : 00:00:30

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: TAN V tank Process
Description: V-tank + ARA waste Decayed 8yrs & 6yrs 2940 gal (1880 gal)
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions			
Height	5.17 cm	2.0 in	
Radius	21.59 cm	8.5 in	

Dose Points			
	X	Y	Z
# 1	24.765 cm 9.8 in	2.59 cm 1.0 in	0 cm 0.0 in
# 2	52.705 cm 1 ft 8.8 in	2.59 cm 1.0 in	0 cm 0.0 in
# 3	83.185 cm 2 ft 8.8 in	2.59 cm 1.0 in	0 cm 0.0 in
# 4	113.665 cm 3 ft 8.8 in	2.59 cm 1.0 in	0 cm 0.0 in
# 5	144.145 cm 4 ft 8.8 in	2.59 cm 1.0 in	0 cm 0.0 in

Shields			
<u>Shield Name</u>	<u>Dimension</u>	<u>Material</u>	<u>Density</u>
Source	462.003 in ³	V123 SLUDGE	1.02
Shield 1	.25 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm³</u>
Ac-225	1.4229e-008	5.2649e+002	1.8795e-006	6.9541e-002
Ac-227	1.2051e-011	4.4588e-001	1.5917e-009	5.8894e-005
Ac-228	3.5267e-022	1.3049e-011	4.6583e-020	1.7236e-015
Ag-108	3.3769e-007	1.2495e+004	4.4604e-005	1.6504e+000
Ag-108m	3.6288e-006	1.3427e+005	4.7932e-004	1.7735e+001
Ag-110	2.4170e-011	8.9427e-001	3.1924e-009	1.1812e-004
Ag-110m	1.8178e-009	6.7260e+001	2.4011e-007	8.8840e-003
Am-241	3.7582e-005	1.3905e+006	4.9640e-003	1.8367e+002
Am-243	1.4706e-011	5.4412e-001	1.9424e-009	7.1871e-005
At-217	1.4229e-008	5.2649e+002	1.8795e-006	6.9541e-002
Ba-137m	2.4850e-002	9.1947e+008	3.2824e+000	1.2145e+005
Bi-210	1.5863e-006	5.8695e+004	2.0953e-004	7.7527e+000
Bi-211	1.1710e-011	4.3328e-001	1.5468e-009	5.7230e-005
Bi-212	7.3530e-013	2.7206e-002	9.7122e-011	3.5935e-006
Bi-213	1.4229e-008	5.2649e+002	1.8795e-006	6.9541e-002
Bi-214	7.2168e-006	2.6702e+005	9.5324e-004	3.5270e+001
Ce-144	3.3089e-008	1.2243e+003	4.3705e-006	1.6171e-001
Cm-242	5.7394e-013	2.1236e-002	7.5809e-011	2.8049e-006
Cm-243	7.4211e-006	2.7458e+005	9.8022e-004	3.6268e+001
Cm-244	6.6177e-006	2.4485e+005	8.7410e-004	3.2342e+001
Co-58	3.5948e-018	1.3301e-007	4.7482e-016	1.7568e-011
Co-60	5.0722e-004	1.8767e+007	6.6996e-002	2.4789e+003
Cs-134	5.8416e-007	2.1614e+004	7.7158e-005	2.8549e+000

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK Pump housing 2 gal decayed 8yr & 6yr plus ARA waste
Run Date: December 1, 2004
Run Time: 4:50:14 PM
Duration : 00:00:30

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Cs-137	2.6280e-002	9.7237e+008	3.4712e+000	1.2844e+005
Eu-152	4.9905e-005	1.8465e+006	6.5917e-003	2.4389e+002
Eu-154	6.7403e-005	2.4939e+006	8.9029e-003	3.2941e+002
Eu-155	4.6229e-006	1.7105e+005	6.1061e-004	2.2593e+001
Fe-55	9.3274e-012	3.4511e-001	1.2320e-009	4.5585e-005
Fr-221	1.4229e-008	5.2649e+002	1.8795e-006	6.9541e-002
Fr-223	1.6612e-013	6.1466e-003	2.1942e-011	8.1187e-007
Gd-152	8.5785e-019	3.1740e-008	1.1331e-016	4.1924e-012
H-3	4.3505e-006	1.6097e+005	5.7464e-004	2.1262e+001
I-129	2.3421e-007	8.6656e+003	3.0935e-005	1.1446e+000
Mn-54	3.3565e-009	1.2419e+002	4.4335e-007	1.6404e-002
Nb-95	4.1531e-018	1.5366e-007	5.4856e-016	2.0297e-011
Nb-95m	1.5932e-020	5.8947e-010	2.1043e-018	7.7860e-014
Ni-63	3.5540e-003	1.3150e+008	4.6942e-001	1.7369e+004
Np-237	1.1438e-007	4.2321e+003	1.5108e-005	5.5899e-001
Np-239	1.4706e-011	5.4412e-001	1.9424e-009	7.1871e-005
Pa-231	1.0281e-010	3.8038e+000	1.3579e-008	5.0243e-004
Pa-233	1.1438e-007	4.2321e+003	1.5108e-005	5.5899e-001
Pa-234	5.8688e-010	2.1715e+001	7.7518e-008	2.8682e-003
Pa-234m	3.6697e-007	1.3578e+004	4.8471e-005	1.7934e+000
Pb-209	1.4229e-008	5.2649e+002	1.8795e-006	6.9541e-002
Pb-210	1.5932e-006	5.8947e+004	2.1043e-004	7.7860e+000
Pb-211	1.1710e-011	4.3328e-001	1.5468e-009	5.7230e-005
Pb-212	7.3530e-013	2.7206e-002	9.7122e-011	3.5935e-006
Pb-214	7.2168e-006	2.6702e+005	9.5324e-004	3.5270e+001
Po-210	1.4910e-006	5.5168e+004	1.9694e-004	7.2869e+000
Po-211	3.1931e-014	1.1815e-003	4.2176e-012	1.5605e-007
Po-212	4.7250e-013	1.7482e-002	6.2410e-011	2.3092e-006
Po-213	1.3957e-008	5.1641e+002	1.8435e-006	6.8210e-002
Po-214	7.2168e-006	2.6702e+005	9.5324e-004	3.5270e+001
Po-215	1.1710e-011	4.3328e-001	1.5468e-009	5.7230e-005
Po-216	7.3530e-013	2.7206e-002	9.7122e-011	3.5935e-006
Po-218	7.2168e-006	2.6702e+005	9.5324e-004	3.5270e+001
Pr-144	3.3089e-008	1.2243e+003	4.3705e-006	1.6171e-001
Pr-144m	4.7318e-010	1.7508e+001	6.2500e-008	2.3125e-003
Pu-238	5.6782e-005	2.1009e+006	7.5000e-003	2.7750e+002
Pu-239	3.1523e-005	1.1663e+006	4.1637e-003	1.5406e+002
Pu-240	2.9412e-005	1.0882e+006	3.8849e-003	1.4374e+002
Ra-223	1.1710e-011	4.3328e-001	1.5468e-009	5.7230e-005
Ra-224	7.3530e-013	2.7206e-002	9.7122e-011	3.5935e-006
Ra-225	1.4366e-008	5.3153e+002	1.8975e-006	7.0207e-002
Ra-226	7.2168e-006	2.6702e+005	9.5324e-004	3.5270e+001
Ra-228	3.5267e-022	1.3049e-011	4.6583e-020	1.7236e-015
Rh-103m	6.5905e-026	2.4385e-015	8.7050e-024	3.2209e-019
Rh-106	1.8110e-007	6.7008e+003	2.3921e-005	8.8507e-001
Rn-219	1.1710e-011	4.3328e-001	1.5468e-009	5.7230e-005
Rn-220	7.3530e-013	2.7206e-002	9.7122e-011	3.5935e-006
Rn-222	7.2168e-006	2.6702e+005	9.5324e-004	3.5270e+001
Ru-103	6.6041e-026	2.4435e-015	8.7230e-024	3.2275e-019
Ru-106	1.8110e-007	6.7008e+003	2.3921e-005	8.8507e-001
Sb-125	2.3897e-006	8.8420e+004	3.1565e-004	1.1679e+001
Sr-90	4.6909e-002	1.7356e+009	6.1960e+000	2.2925e+005
Te-125m	5.8484e-007	2.1639e+004	7.7248e-005	2.8582e+000
Th-227	1.1642e-011	4.3076e-001	1.5378e-009	5.6897e-005
Th-228	7.3530e-013	2.7206e-002	9.7122e-011	3.5935e-006
Th-229	1.4434e-008	5.3405e+002	1.9065e-006	7.0540e-002
Th-230	1.5795e-009	5.8443e+001	2.0863e-007	7.7194e-003
Th-231	6.1207e-007	2.2647e+004	8.0845e-005	2.9913e+000
Th-232	1.3753e-021	5.0885e-011	1.8165e-019	6.7212e-015
Th-234	3.6697e-007	1.3578e+004	4.8471e-005	1.7934e+000

ENGINEERING DESIGN FILE

Page : 3
 DOS File : VTANK Pump housing 2 gal decayed 8yr & 6yr plus ARA waste
 Run Date: December 1, 2004
 Run Time: 4:50:14 PM
 Duration : 00:00:30

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Tl-207	1.1642e-011	4.3076e-001	1.5378e-009	5.6897e-005
Tl-208	2.6484e-013	9.7992e-003	3.4982e-011	1.2943e-006
Tl-209	3.0774e-010	1.1386e+001	4.0647e-008	1.5040e-003
U-233	1.9200e-005	7.1038e+005	2.5360e-003	9.3831e+001
U-234	2.2468e-005	8.3130e+005	2.9676e-003	1.0980e+002
U-235	6.1207e-007	2.2647e+004	8.0845e-005	2.9913e+000
U-236	6.9445e-012	2.5695e-001	9.1727e-010	3.3939e-005
U-238	3.6697e-007	1.3578e+004	4.8471e-005	1.7934e+000
Y-90	4.6909e-002	1.7356e+009	6.1960e+000	2.2925e+005
Zn-65	1.8723e-009	6.9275e+001	2.4730e-007	9.1502e-003
Zr-95	1.8791e-018	6.9527e-008	2.4820e-016	9.1835e-012

Buildup

The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (9.75,1.02e+00,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	4.352e+01	1.985e-131	2.019e-30	1.702e-132	1.732e-31
0.02	8.825e+04	3.894e-59	8.971e-27	1.349e-60	3.108e-28
0.03	5.427e+07	1.246e-17	1.233e-16	1.235e-19	1.222e-18
0.04	1.442e+07	7.170e-08	1.594e-06	3.171e-10	7.050e-09
0.05	4.191e+05	2.119e-05	6.885e-04	5.644e-08	1.834e-06
0.06	5.064e+05	2.025e-03	6.634e-02	4.022e-06	1.318e-04
0.08	1.279e+05	2.309e-02	5.043e-01	3.655e-05	7.980e-04
0.1	1.710e+06	1.484e+00	2.090e+01	2.271e-03	3.197e-02
0.15	4.922e+03	1.956e-02	1.403e-01	3.221e-05	2.310e-04
0.2	3.963e+05	2.994e+00	1.523e+01	5.285e-03	2.688e-02
0.3	5.975e+05	9.105e+00	3.284e+01	1.727e-02	6.230e-02
0.4	3.847e+05	9.139e+00	2.725e+01	1.781e-02	5.310e-02
0.5	3.151e+04	1.043e+00	2.725e+00	2.047e-03	5.349e-03
0.6	8.279e+08	3.576e+04	8.479e+04	6.981e+01	1.655e+02
0.8	1.469e+06	9.598e+01	1.974e+02	1.826e-01	3.755e-01
1.0	2.041e+07	1.832e+03	3.445e+03	3.376e+00	6.351e+00
1.5	2.022e+07	3.189e+03	5.178e+03	5.365e+00	8.712e+00
2.0	7.147e+04	1.656e+01	2.485e+01	2.560e-02	3.844e-02
3.0	9.780e-03	3.804e-06	5.215e-06	5.161e-09	7.076e-09
TOTALS:	9.430e+08	4.092e+04	9.373e+04	7.880e+01	1.811e+02

Results - Dose Point # 2 - (20.75,1.02e+00,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	4.352e+01	2.917e-131	2.674e-31	2.502e-132	2.294e-32
0.02	8.825e+04	1.215e-59	1.188e-27	4.208e-61	4.116e-29
0.03	5.427e+07	1.975e-18	1.949e-17	1.958e-20	1.932e-19
0.04	1.442e+07	9.269e-09	2.031e-07	4.099e-11	8.984e-10
0.05	4.191e+05	2.290e-06	7.258e-05	6.100e-09	1.933e-07
0.06	5.064e+05	1.991e-04	6.439e-03	3.956e-07	1.279e-05
0.08	1.279e+05	2.148e-03	4.875e-02	3.398e-06	7.715e-05
0.1	1.710e+06	1.370e-01	2.108e+00	2.096e-04	3.225e-03

ENGINEERING DESIGN FILE

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 DOS File : VTANK Pump housing 2 gal decayed 8yr & 6yr plus ARA waste
 Run Date: December 1, 2004
 Run Time: 4:50:14 PM
 Duration : 00:00:30

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.15	4.922e+03	1.823e-03	1.519e-02	3.002e-06	2.501e-05
0.2	3.963e+05	2.833e-01	1.704e+00	5.001e-04	3.008e-03
0.3	5.975e+05	8.844e-01	3.769e+00	1.678e-03	7.150e-03
0.4	3.847e+05	9.064e-01	3.164e+00	1.766e-03	6.166e-03
0.5	3.151e+04	1.052e-01	3.188e-01	2.065e-04	6.258e-04
0.6	8.279e+08	3.661e+03	9.972e+03	7.146e+00	1.946e+01
0.8	1.469e+06	1.006e+01	2.344e+01	1.913e-02	4.458e-02
1.0	2.041e+07	1.955e+02	4.113e+02	3.604e-01	7.582e-01
1.5	2.022e+07	3.518e+02	6.258e+02	5.919e-01	1.053e+00
2.0	7.147e+04	1.867e+00	3.031e+00	2.887e-03	4.686e-03
3.0	9.780e-03	4.411e-07	6.428e-07	5.984e-10	8.722e-10
TOTALS:	9.430e+08	4.223e+03	1.105e+04	8.125e+00	2.134e+01

Results - Dose Point # 3 - (32.75,1.02e+00,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	4.352e+01	1.036e-131	1.016e-31	8.890e-133	8.715e-33
0.02	8.825e+04	4.321e-60	4.515e-28	1.497e-61	1.564e-29
0.03	5.427e+07	6.524e-19	6.438e-18	6.466e-21	6.380e-20
0.04	1.442e+07	3.053e-09	6.696e-08	1.350e-11	2.961e-10
0.05	4.191e+05	7.591e-07	2.414e-05	2.022e-09	6.431e-08
0.06	5.064e+05	6.654e-05	2.168e-03	1.322e-07	4.307e-06
0.08	1.279e+05	7.274e-04	1.684e-02	1.151e-06	2.664e-05
0.1	1.710e+06	4.681e-02	7.423e-01	7.162e-05	1.136e-03
0.15	4.922e+03	6.305e-04	5.477e-03	1.038e-06	9.019e-06
0.2	3.963e+05	9.864e-02	6.201e-01	1.741e-04	1.094e-03
0.3	5.975e+05	3.105e-01	1.381e+00	5.890e-04	2.619e-03
0.4	3.847e+05	3.202e-01	1.163e+00	6.238e-04	2.266e-03
0.5	3.151e+04	3.734e-02	1.174e-01	7.330e-05	2.305e-04
0.6	8.279e+08	1.304e+03	3.678e+03	2.546e+00	7.178e+00
0.8	1.469e+06	3.606e+00	8.665e+00	6.859e-03	1.648e-02
1.0	2.041e+07	7.043e+01	1.523e+02	1.298e-01	2.807e-01
1.5	2.022e+07	1.278e+02	2.324e+02	2.150e-01	3.911e-01
2.0	7.147e+04	6.820e-01	1.128e+00	1.055e-03	1.745e-03
3.0	9.780e-03	1.622e-07	2.400e-07	2.201e-10	3.256e-10
TOTALS:	9.430e+08	1.508e+03	4.076e+03	2.901e+00	7.876e+00

Results - Dose Point # 4 - (44.75,1.02e+00,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	4.352e+01	5.027e-132	5.354e-32	4.312e-133	4.593e-33
0.02	8.825e+04	2.114e-60	2.379e-28	7.323e-62	8.241e-30
0.03	5.427e+07	3.192e-19	3.151e-18	3.164e-21	3.122e-20
0.04	1.442e+07	1.499e-09	3.290e-08	6.630e-12	1.455e-10
0.05	4.191e+05	3.744e-07	1.193e-05	9.974e-10	3.178e-08
0.06	5.064e+05	3.296e-05	1.079e-03	6.548e-08	2.143e-06
0.08	1.279e+05	3.628e-04	8.481e-03	5.741e-07	1.342e-05
0.1	1.710e+06	2.346e-02	3.775e-01	3.589e-05	5.776e-04
0.15	4.922e+03	3.178e-04	2.815e-03	5.233e-07	4.635e-06
0.2	3.963e+05	4.988e-02	3.201e-01	8.803e-05	5.649e-04
0.3	5.975e+05	1.576e-01	7.151e-01	2.990e-04	1.356e-03
0.4	3.847e+05	1.630e-01	6.032e-01	3.176e-04	1.175e-03

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK Pump housing 2 gal decayed 8yr & 6yr plus ARA waste
 Run Date: December 1, 2004
 Run Time: 4:50:14 PM
 Duration : 00:00:30

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.5	3.151e+04	1.906e-02	6.096e-02	3.740e-05	1.197e-04
0.6	8.279e+08	6.669e+02	1.911e+03	1.302e+00	3.730e+00
0.8	1.469e+06	1.849e+00	4.508e+00	3.517e-03	8.574e-03
1.0	2.041e+07	3.620e+01	7.929e+01	6.672e-02	1.461e-01
1.5	2.022e+07	6.595e+01	1.212e+02	1.110e-01	2.039e-01
2.0	7.147e+04	3.528e-01	5.889e-01	5.456e-04	9.107e-04
3.0	9.780e-03	8.420e-08	1.254e-07	1.142e-10	1.702e-10
TOTALS:	9.430e+08	7.716e+02	2.118e+03	1.484e+00	4.093e+00

Results - Dose Point # 5 - (56.75,1.02e+00,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	4.352e+01	2.874e-132	3.306e-32	2.465e-133	2.836e-33
0.02	8.825e+04	1.230e-60	1.469e-28	4.260e-62	5.089e-30
0.03	5.427e+07	1.878e-19	1.853e-18	1.861e-21	1.837e-20
0.04	1.442e+07	8.854e-10	1.944e-08	3.916e-12	8.599e-11
0.05	4.191e+05	2.219e-07	7.081e-06	5.910e-10	1.886e-08
0.06	5.064e+05	1.959e-05	6.430e-04	3.891e-08	1.277e-06
0.08	1.279e+05	2.165e-04	5.095e-03	3.427e-07	8.063e-06
0.1	1.710e+06	1.404e-02	2.281e-01	2.148e-05	3.490e-04
0.15	4.922e+03	1.909e-04	1.712e-03	3.144e-07	2.820e-06
0.2	3.963e+05	3.002e-02	1.952e-01	5.299e-05	3.445e-04
0.3	5.975e+05	9.514e-02	4.370e-01	1.805e-04	8.289e-04
0.4	3.847e+05	9.856e-02	3.689e-01	1.920e-04	7.189e-04
0.5	3.151e+04	1.154e-02	3.731e-02	2.265e-05	7.324e-05
0.6	8.279e+08	4.043e+02	1.170e+03	7.891e-01	2.284e+00
0.8	1.469e+06	1.123e+00	2.762e+00	2.136e-03	5.254e-03
1.0	2.041e+07	2.202e+01	4.861e+01	4.058e-02	8.960e-02
1.5	2.022e+07	4.021e+01	7.437e+01	6.765e-02	1.251e-01
2.0	7.147e+04	2.155e-01	3.616e-01	3.332e-04	5.592e-04
3.0	9.780e-03	5.152e-08	7.708e-08	6.990e-11	1.046e-10
TOTALS:	9.430e+08	4.681e+02	1.297e+03	9.003e-01	2.507e+00

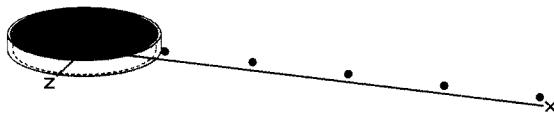
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
DOS File : VTANK Pump housing 2 gal decayed 8yr & 6yr plus ARA waste
Run Date: December 1, 2004
Run Time: 4:53:35 PM
Duration : 00:00:33

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: TAN V tank Process
Description: V-tank+ARA waste Decayed 8yr&6yr 2940 gal (1880 gal) 3/8" Pb
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions

Height	5.17 cm	2.0 in
Radius	21.59 cm	8.5 in

Dose Points

#	X	Y	Z
# 1	25.7175 cm 10.1 in	2.59 cm 1.0 in	0 cm 0.0 in
# 2	53.6575 cm 1 ft 9.1 in	2.59 cm 1.0 in	0 cm 0.0 in
# 3	84.1375 cm 2 ft 9.1 in	2.59 cm 1.0 in	0 cm 0.0 in
# 4	114.6175 cm 3 ft 9.1 in	2.59 cm 1.0 in	0 cm 0.0 in
# 5	145.0975 cm 4 ft 9.1 in	2.59 cm 1.0 in	0 cm 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	462.003 in ³	V123 SLUDGE	1.02
Shield 1	.25 in	Iron	7.86
Shield 2	.375 in	Lead	11.34
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices

Number of Groups : 25

Lower Energy Cutoff : 0.015

Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	1.4229e-008	5.2649e+002	1.8795e-006	6.9541e-002
Ac-227	1.2051e-011	4.4588e-001	1.5917e-009	5.8894e-005
Ac-228	3.5267e-022	1.3049e-011	4.6583e-020	1.7236e-015
Ag-108	3.3769e-007	1.2495e+004	4.4604e-005	1.6504e+000
Ag-108m	3.6288e-006	1.3427e+005	4.7932e-004	1.7735e+001
Ag-110	2.4170e-011	8.9427e-001	3.1924e-009	1.1812e-004
Ag-110m	1.8178e-009	6.7260e+001	2.4011e-007	8.8840e-003
Am-241	3.7582e-005	1.3905e+006	4.9640e-003	1.8367e+002
Am-243	1.4706e-011	5.4412e-001	1.9424e-009	7.1871e-005
At-217	1.4229e-008	5.2649e+002	1.8795e-006	6.9541e-002
Ba-137m	2.4850e-002	9.1947e+008	3.2824e+000	1.2145e+005
Bi-210	1.5863e-006	5.8695e+004	2.0953e-004	7.7527e+000
Bi-211	1.1710e-011	4.3328e-001	1.5468e-009	5.7230e-005
Bi-212	7.3530e-013	2.7206e-002	9.7122e-011	3.5935e-006
Bi-213	1.4229e-008	5.2649e+002	1.8795e-006	6.9541e-002
Bi-214	7.2168e-006	2.6702e+005	9.5324e-004	3.5270e+001
Ce-144	3.3089e-008	1.2243e+003	4.3705e-006	1.6171e-001
Cm-242	5.7394e-013	2.1236e-002	7.5809e-011	2.8049e-006
Cm-243	7.4211e-006	2.7458e+005	9.8022e-004	3.6268e+001
Cm-244	6.6177e-006	2.4485e+005	8.7410e-004	3.2342e+001
Co-58	3.5948e-018	1.3301e-007	4.7482e-016	1.7568e-011
Co-60	5.0722e-004	1.8767e+007	6.6996e-002	2.4789e+003

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Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Cs-134	5.8416e-007	2.1614e+004	7.7158e-005	2.8549e+000
Cs-137	2.6280e-002	9.7237e+008	3.4712e+000	1.2844e+005
Eu-152	4.9905e-005	1.8465e+006	6.5917e-003	2.4389e+002
Eu-154	6.7403e-005	2.4939e+006	8.9029e-003	3.2941e+002
Eu-155	4.6229e-006	1.7105e+005	6.1061e-004	2.2593e+001
Fe-55	9.3274e-012	3.4511e-001	1.2320e-009	4.5585e-005
Fr-221	1.4229e-008	5.2649e+002	1.8795e-006	6.9541e-002
Fr-223	1.6612e-013	6.1466e-003	2.1942e-011	8.1187e-007
Gd-152	8.5785e-019	3.1740e-008	1.1331e-016	4.1924e-012
H-3	4.3505e-006	1.6097e+005	5.7464e-004	2.1262e+001
I-129	2.3421e-007	8.6656e+003	3.0935e-005	1.1446e+000
Mn-54	3.3565e-009	1.2419e+002	4.4335e-007	1.6404e-002
Nb-95	4.1531e-018	1.5366e-007	5.4856e-016	2.0297e-011
Nb-95m	1.5932e-020	5.8947e-010	2.1043e-018	7.7860e-014
Ni-63	3.5540e-003	1.3150e+008	4.6942e-001	1.7369e+004
Np-237	1.1438e-007	4.2321e+003	1.5108e-005	5.5899e-001
Np-239	1.4706e-011	5.4412e-001	1.9424e-009	7.1871e-005
Pa-231	1.0281e-010	3.8038e+000	1.3579e-008	5.0243e-004
Pa-233	1.1438e-007	4.2321e+003	1.5108e-005	5.5899e-001
Pa-234	5.8688e-010	2.1715e+001	7.7518e-008	2.8682e-003
Pa-234m	3.6697e-007	1.3578e+004	4.8471e-005	1.7934e+000
Pb-209	1.4229e-008	5.2649e+002	1.8795e-006	6.9541e-002
Pb-210	1.5932e-006	5.8947e+004	2.1043e-004	7.7860e+000
Pb-211	1.1710e-011	4.3328e-001	1.5468e-009	5.7230e-005
Pb-212	7.3530e-013	2.7206e-002	9.7122e-011	3.5935e-006
Pb-214	7.2168e-006	2.6702e+005	9.5324e-004	3.5270e+001
Po-210	1.4910e-006	5.5168e+004	1.9694e-004	7.2869e+000
Po-211	3.1931e-014	1.1815e-003	4.2176e-012	1.5605e-007
Po-212	4.7250e-013	1.7482e-002	6.2410e-011	2.3092e-006
Po-213	1.3957e-008	5.1641e+002	1.8435e-006	6.8210e-002
Po-214	7.2168e-006	2.6702e+005	9.5324e-004	3.5270e+001
Po-215	1.1710e-011	4.3328e-001	1.5468e-009	5.7230e-005
Po-216	7.3530e-013	2.7206e-002	9.7122e-011	3.5935e-006
Po-218	7.2168e-006	2.6702e+005	9.5324e-004	3.5270e+001
Pr-144	3.3089e-008	1.2243e+003	4.3705e-006	1.6171e-001
Pr-144m	4.7318e-010	1.7508e+001	6.2500e-008	2.3125e-003
Pu-238	5.6782e-005	2.1009e+006	7.5000e-003	2.7750e+002
Pu-239	3.1523e-005	1.1663e+006	4.1637e-003	1.5406e+002
Pu-240	2.9412e-005	1.0882e+006	3.8849e-003	1.4374e+002
Ra-223	1.1710e-011	4.3328e-001	1.5468e-009	5.7230e-005
Ra-224	7.3530e-013	2.7206e-002	9.7122e-011	3.5935e-006
Ra-225	1.4366e-008	5.3153e+002	1.8975e-006	7.0207e-002
Ra-226	7.2168e-006	2.6702e+005	9.5324e-004	3.5270e+001
Ra-228	3.5267e-022	1.3049e-011	4.6583e-020	1.7236e-015
Rh-103m	6.5905e-026	2.4385e-015	8.7050e-024	3.2209e-019
Rh-106	1.8110e-007	6.7008e+003	2.3921e-005	8.8507e-001
Rn-219	1.1710e-011	4.3328e-001	1.5468e-009	5.7230e-005
Rn-220	7.3530e-013	2.7206e-002	9.7122e-011	3.5935e-006
Rn-222	7.2168e-006	2.6702e+005	9.5324e-004	3.5270e+001
Ru-103	6.6041e-026	2.4435e-015	8.7230e-024	3.2275e-019
Ru-106	1.8110e-007	6.7008e+003	2.3921e-005	8.8507e-001
Sb-125	2.3897e-006	8.8420e+004	3.1565e-004	1.1679e+001
Sr-90	4.6909e-002	1.7356e+009	6.1960e+000	2.2925e+005
Te-125m	5.8484e-007	2.1639e+004	7.7248e-005	2.8582e+000
Th-227	1.1642e-011	4.3076e-001	1.5378e-009	5.6897e-005
Th-228	7.3530e-013	2.7206e-002	9.7122e-011	3.5935e-006
Th-229	1.4434e-008	5.3405e+002	1.9065e-006	7.0540e-002
Th-230	1.5795e-009	5.8443e+001	2.0863e-007	7.7194e-003
Th-231	6.1207e-007	2.2647e+004	8.0845e-005	2.9913e+000
Th-232	1.3753e-021	5.0885e-011	1.8165e-019	6.7212e-015

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 DOS File : VTANK Pump housing 2 gal decayed 8yr & 6yr plus ARA waste
 Run Date: December 1, 2004
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<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Th-234	3.6697e-007	1.3578e+004	4.8471e-005	1.7934e+000
Tl-207	1.1642e-011	4.3076e-001	1.5378e-009	5.6897e-005
Tl-208	2.6484e-013	9.7992e-003	3.4982e-011	1.2943e-006
Tl-209	3.0774e-010	1.1386e+001	4.0647e-008	1.5040e-003
U-233	1.9200e-005	7.1038e+005	2.5360e-003	9.3831e+001
U-234	2.2468e-005	8.3130e+005	2.9676e-003	1.0980e+002
U-235	6.1207e-007	2.2647e+004	8.0845e-005	2.9913e+000
U-236	6.9445e-012	2.5695e-001	9.1727e-010	3.3939e-005
U-238	3.6697e-007	1.3578e+004	4.8471e-005	1.7934e+000
Y-90	4.6909e-002	1.7356e+009	6.1960e+000	2.2925e+005
Zn-65	1.8723e-009	6.9275e+001	2.4730e-007	9.1502e-003
Zr-95	1.8791e-018	6.9527e-008	2.4820e-016	9.1835e-012

Buildup
The material reference is : Shield 2

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (10.125,1.02e+00,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	4.352e+01	0.000e+00	1.166e-30	0.000e+00	1.000e-31
0.02	8.825e+04	0.000e+00	3.153e-27	0.000e+00	1.092e-28
0.03	5.427e+07	7.792e-155	2.990e-24	7.722e-157	2.963e-26
0.04	1.442e+07	5.146e-72	1.089e-24	2.276e-74	4.816e-27
0.05	4.191e+05	4.851e-41	4.080e-26	1.292e-43	1.087e-28
0.06	5.064e+05	1.400e-25	2.072e-25	2.781e-28	4.115e-28
0.08	1.279e+05	5.254e-13	6.375e-13	8.314e-16	1.009e-15
0.1	1.710e+06	1.188e-26	1.241e-08	1.818e-29	1.898e-11
0.15	4.922e+03	3.841e-12	1.212e-11	6.325e-15	1.996e-14
0.2	3.963e+05	3.450e-05	4.709e-05	6.089e-08	8.312e-08
0.3	5.975e+05	7.208e-02	9.703e-02	1.367e-04	1.840e-04
0.4	3.847e+05	4.898e-01	7.025e-01	9.543e-04	1.369e-03
0.5	3.151e+04	1.252e-01	1.878e-01	2.457e-04	3.687e-04
0.6	8.279e+08	6.525e+03	1.002e+04	1.274e+01	1.956e+01
0.8	1.469e+06	2.662e+01	4.223e+01	5.063e-02	8.033e-02
1.0	2.041e+07	6.262e+02	9.994e+02	1.154e+00	1.842e+00
1.5	2.022e+07	1.368e+03	2.078e+03	2.302e+00	3.495e+00
2.0	7.147e+04	7.661e+00	1.140e+01	1.185e-02	1.763e-02
3.0	9.780e-03	1.844e-06	2.641e-06	2.502e-09	3.583e-09
TOTALS:	9.430e+08	8.554e+03	1.315e+04	1.626e+01	2.500e+01

Results - Dose Point # 2 - (21.125,1.02e+00,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	4.352e+01	0.000e+00	1.722e-31	0.000e+00	1.477e-32
0.02	8.825e+04	0.000e+00	4.655e-28	0.000e+00	1.613e-29
0.03	5.427e+07	4.734e-155	4.414e-25	4.692e-157	4.375e-27
0.04	1.442e+07	1.408e-72	1.608e-25	6.227e-75	7.111e-28
0.05	4.191e+05	1.092e-41	6.024e-27	2.910e-44	1.605e-29
0.06	5.064e+05	2.753e-26	3.845e-26	5.468e-29	7.637e-29
0.08	1.279e+05	8.374e-14	1.016e-13	1.325e-16	1.607e-16

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 Run Date: December 1, 2004
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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.1	1.710e+06	2.435e-27	1.833e-09	3.725e-30	2.804e-12
0.15	4.922e+03	6.045e-13	1.899e-12	9.954e-16	3.127e-15
0.2	3.963e+05	4.724e-06	6.446e-06	8.337e-09	1.138e-08
0.3	5.975e+05	8.981e-03	1.211e-02	1.704e-05	2.297e-05
0.4	3.847e+05	5.977e-02	8.618e-02	1.165e-04	1.679e-04
0.5	3.151e+04	1.523e-02	2.308e-02	2.990e-05	4.530e-05
0.6	8.279e+08	7.967e+02	1.240e+03	1.555e+00	2.421e+00
0.8	1.469e+06	3.286e+00	5.315e+00	6.249e-03	1.011e-02
1.0	2.041e+07	7.819e+01	1.278e+02	1.441e-01	2.355e-01
1.5	2.022e+07	1.751e+02	2.732e+02	2.946e-01	4.597e-01
2.0	7.147e+04	9.983e-01	1.526e+00	1.544e-03	2.359e-03
3.0	9.780e-03	2.463e-07	3.605e-07	3.342e-10	4.890e-10
TOTALS:	9.430e+08	1.054e+03	1.648e+03	2.002e+00	3.129e+00

Results - Dose Point # 3 - (33.125,1.02e+00,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	4.352e+01	0.000e+00	6.645e-32	0.000e+00	5.700e-33
0.02	8.825e+04	0.000e+00	1.797e-28	0.000e+00	6.223e-30
0.03	5.427e+07	1.834e-155	1.704e-25	1.818e-157	1.688e-27
0.04	1.442e+07	5.324e-73	6.205e-26	2.355e-75	2.744e-28
0.05	4.191e+05	3.885e-42	2.325e-27	1.035e-44	6.193e-30
0.06	5.064e+05	9.641e-27	1.380e-26	1.915e-29	2.742e-29
0.08	1.279e+05	2.926e-14	3.549e-14	4.630e-17	5.616e-17
0.1	1.710e+06	8.725e-28	7.073e-10	1.335e-30	1.082e-12
0.15	4.922e+03	2.148e-13	6.756e-13	3.537e-16	1.113e-15
0.2	3.963e+05	1.680e-06	2.293e-06	2.965e-09	4.047e-09
0.3	5.975e+05	3.213e-03	4.337e-03	6.094e-06	8.226e-06
0.4	3.847e+05	2.150e-02	3.107e-02	4.189e-05	6.053e-05
0.5	3.151e+04	5.505e-03	8.370e-03	1.081e-05	1.643e-05
0.6	8.279e+08	2.890e+02	4.520e+02	5.641e-01	8.823e-01
0.8	1.469e+06	1.199e+00	1.952e+00	2.281e-03	3.713e-03
1.0	2.041e+07	2.868e+01	4.720e+01	5.286e-02	8.701e-02
1.5	2.022e+07	6.475e+01	1.019e+02	1.089e-01	1.714e-01
2.0	7.147e+04	3.712e-01	5.719e-01	5.741e-04	8.844e-04
3.0	9.780e-03	9.222e-08	1.359e-07	1.251e-10	1.843e-10
TOTALS:	9.430e+08	3.840e+02	6.037e+02	7.288e-01	1.145e+00

Results - Dose Point # 4 - (45.125,1.02e+00,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	4.352e+01	0.000e+00	3.525e-32	0.000e+00	3.024e-33
0.02	8.825e+04	0.000e+00	9.530e-29	0.000e+00	3.301e-30
0.03	5.427e+07	9.425e-156	9.037e-26	9.341e-158	8.956e-28
0.04	1.442e+07	2.703e-73	3.292e-26	1.195e-75	1.456e-28
0.05	4.191e+05	1.947e-42	1.233e-27	5.187e-45	3.285e-30
0.06	5.064e+05	4.838e-27	7.020e-27	9.610e-30	1.394e-29
0.08	1.279e+05	1.471e-14	1.785e-14	2.329e-17	2.825e-17
0.1	1.710e+06	4.423e-28	3.752e-10	6.767e-31	5.740e-13
0.15	4.922e+03	1.090e-13	3.431e-13	1.794e-16	5.649e-16
0.2	3.963e+05	8.543e-07	1.166e-06	1.508e-09	2.058e-09
0.3	5.975e+05	1.641e-03	2.216e-03	3.112e-06	4.203e-06

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 Run Date: December 1, 2004
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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
0.4	3.847e+05	1.102e-02	1.594e-02	2.146e-05	3.105e-05
0.5	3.151e+04	2.828e-03	4.308e-03	5.551e-06	8.455e-06
0.6	8.279e+08	1.488e+02	2.332e+02	2.904e-01	4.552e-01
0.8	1.469e+06	6.192e-01	1.011e+00	1.178e-03	1.923e-03
1.0	2.041e+07	1.484e+01	2.452e+01	2.736e-02	4.520e-02
1.5	2.022e+07	3.365e+01	5.317e+01	5.662e-02	8.946e-02
2.0	7.147e+04	1.934e-01	2.992e-01	2.991e-04	4.626e-04
3.0	9.780e-03	4.821e-08	7.125e-08	6.541e-11	9.666e-11
TOTALS:	9.430e+08	1.981e+02	3.123e+02	3.758e-01	5.923e-01

Results - Dose Point # 5 - (57.125,1.02e+00,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
0.015	4.352e+01	0.000e+00	2.185e-32	0.000e+00	1.874e-33
0.02	8.825e+04	0.000e+00	5.907e-29	0.000e+00	2.046e-30
0.03	5.427e+07	5.673e-156	5.601e-26	5.622e-158	5.551e-28
0.04	1.442e+07	1.617e-73	2.040e-26	7.152e-76	9.023e-29
0.05	4.191e+05	1.162e-42	7.644e-28	3.094e-45	2.036e-30
0.06	5.064e+05	2.892e-27	4.231e-27	5.743e-30	8.404e-30
0.08	1.279e+05	8.813e-15	1.069e-14	1.395e-17	1.692e-17
0.1	1.710e+06	2.660e-28	2.325e-10	4.069e-31	3.557e-13
0.15	4.922e+03	6.563e-14	2.067e-13	1.081e-16	3.404e-16
0.2	3.963e+05	5.154e-07	7.038e-07	9.097e-10	1.242e-09
0.3	5.975e+05	9.929e-04	1.341e-03	1.884e-06	2.545e-06
0.4	3.847e+05	6.681e-03	9.673e-03	1.302e-05	1.885e-05
0.5	3.151e+04	1.718e-03	2.620e-03	3.372e-06	5.143e-06
0.6	8.279e+08	9.049e+01	1.421e+02	1.766e-01	2.773e-01
0.8	1.469e+06	3.774e-01	6.176e-01	7.179e-04	1.175e-03
1.0	2.041e+07	9.061e+00	1.500e+01	1.670e-02	2.765e-02
1.5	2.022e+07	2.060e+01	3.263e+01	3.465e-02	5.489e-02
2.0	7.147e+04	1.186e-01	1.838e-01	1.834e-04	2.843e-04
3.0	9.780e-03	2.961e-08	4.385e-08	4.018e-11	5.949e-11
TOTALS:	9.430e+08	1.207e+02	1.905e+02	2.289e-01	3.614e-01

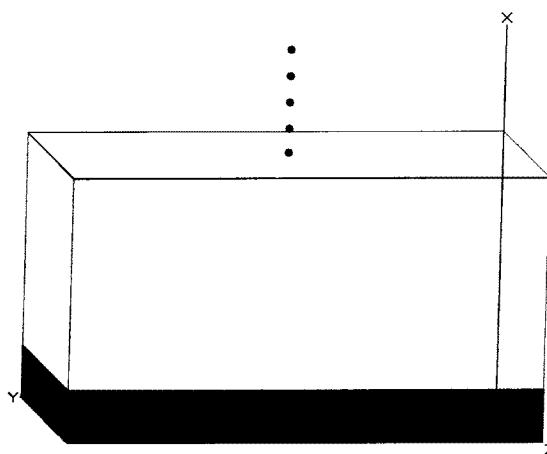
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
DOS File : VTANK V-3 vessel 652gal decayed 8yr homog mix H2O no shiel
Run Date: November 1, 2004
Run Time: 10:57:50 AM
Duration : 00:00:30

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: VTANK V-3 vessel
Description: 652 gal batch decayed 8 yrs homog mix no shield sens 1' step
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	60.96 cm	2 ft
Width	304.8 cm	10 ft 0.0 in
Height	548.64 cm	18 ft

Dose Points

#	X	Y	Z
# 1	308.9024 cm	274.32 cm	152.4 cm
	10 ft 1.6 in	9 ft	5 ft 0.0 in
# 2	336.8424 cm	274.32 cm	152.4 cm
	11 ft 0.6 in	9 ft	5 ft 0.0 in
# 3	367.3224 cm	274.32 cm	152.4 cm
	12 ft 0.6 in	9 ft	5 ft 0.0 in
# 4	397.8024 cm	274.32 cm	152.4 cm
	13 ft 0.6 in	9 ft	5 ft 0.0 in
# 5	428.2824 cm	274.32 cm	152.4 cm
	14 ft 0.6 in	9 ft	5 ft 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	6.22e+05 in ³	V123 SLUDGE	1.02
Shield 2	96.24 in	Air	0.00122
Shield 3	.375 in	Iron	7.86
Air Gap		Air	0.00122

Source Input

Grouping Method : Standard Indices

Number of Groups : 25

Lower Energy Cutoff : 0.015

Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	3.6252e-006	1.3413e+005	3.5562e-007	1.3158e-002
Ac-227	3.1505e-009	1.1657e+002	3.0905e-010	1.1435e-005
Ac-228	1.7993e-019	6.6573e-009	1.7650e-020	6.5306e-016
Ag-108	1.8429e-004	6.8186e+006	1.8078e-005	6.6888e-001
Ag-108m	1.9816e-003	7.3318e+007	1.9438e-004	7.1922e+000
Ag-110	1.4842e-008	5.4917e+002	1.4560e-009	5.3871e-005
Ag-110m	1.1160e-006	4.1291e+004	1.0947e-007	4.0505e-003
Am-241	1.5401e-002	5.6984e+008	1.5108e-003	5.5899e+001
Am-243	7.1748e-009	2.6547e+002	7.0382e-010	2.6041e-005
At-217	3.6252e-006	1.3413e+005	3.5562e-007	1.3158e-002
Ba-137m	1.2988e+001	4.8057e+011	1.2741e+000	4.7142e+004
Bi-210	1.3917e-003	5.1494e+007	1.3652e-004	5.0514e+000
Bi-211	3.0620e-009	1.1330e+002	3.0037e-010	1.1114e-005
Bi-212	8.2187e-020	3.0409e-009	8.0622e-021	2.9830e-016
Bi-213	3.6252e-006	1.3413e+005	3.5562e-007	1.3158e-002
Bi-214	6.3268e-003	2.3409e+008	6.2064e-004	2.2964e+001
Ce-144	2.3681e-005	8.7619e+005	2.3230e-006	8.5951e-002
Cm-242	4.2798e-010	1.5835e+001	4.1983e-011	1.5534e-006
Cm-243	3.6056e-003	1.3341e+008	3.5369e-004	1.3087e+001
Cm-244	3.2247e-003	1.1932e+008	3.1634e-004	1.1704e+001
Co-58	1.3829e-015	5.1169e-005	1.3566e-016	5.0194e-012
Co-60	1.4249e-001	5.2720e+009	1.3977e-002	5.1717e+002

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK V-3 vessel 652gal decayed 8yr homog mix H2O no shiel
Run Date: November 1, 2004
Run Time: 10:57:50 AM
Duration : 00:00:30

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Cs-134	2.2418e-004	8.2947e+006	2.1991e-005	8.1368e-001
Cs-137	1.3730e+001	5.0800e+011	1.3468e+000	4.9833e+004
Eu-152	2.6473e-002	9.7951e+008	2.5969e-003	9.6086e+001
Eu-154	3.6424e-002	1.3477e+009	3.5731e-003	1.3220e+002
Eu-155	3.0634e-003	1.1335e+008	3.0051e-004	1.1119e+001
Fr-221	3.6252e-006	1.3413e+005	3.5562e-007	1.3158e-002
Fr-223	4.3476e-011	1.6086e+000	4.2648e-012	1.5780e-007
Gd-152	4.5805e-016	1.6948e-005	4.4933e-017	1.6625e-012
I-129	1.5300e-004	5.6610e+006	1.5009e-005	5.5532e-001
Mn-54	1.9998e-006	7.3994e+004	1.9618e-007	7.2585e-003
Nb-95	3.2292e-016	1.1948e-005	3.1677e-017	1.1720e-012
Nb-95m	1.2384e-018	4.5820e-008	1.2148e-019	4.4948e-015
Ni-63	1.9679e+000	7.2813e+010	1.9304e-001	7.1426e+003
Np-237	6.4640e-005	2.3917e+006	6.3409e-006	2.3461e-001
Np-239	7.1673e-009	2.6519e+002	7.0308e-010	2.6014e-005
Pa-231	2.6897e-008	9.9519e+002	2.6385e-009	9.7624e-005
Pa-233	6.4639e-005	2.3917e+006	6.3409e-006	2.3461e-001
Pa-234	2.3840e-007	8.8208e+003	2.3386e-008	8.6529e-004
Pa-234m	1.4900e-004	5.5130e+006	1.4616e-005	5.4080e-001
Pb-209	3.6249e-006	1.3412e+005	3.5559e-007	1.3157e-002
Pb-210	1.3948e-003	5.1607e+007	1.3682e-004	5.0624e+000
Pb-211	3.0620e-009	1.1330e+002	3.0037e-010	1.1114e-005
Pb-212	8.2193e-020	3.0411e-009	8.0628e-021	2.9833e-016
Pb-214	6.3268e-003	2.3409e+008	6.2064e-004	2.2964e+001
Po-210	1.3063e-003	4.8332e+007	1.2814e-004	4.7412e+000
Po-211	8.3593e-012	3.0930e-001	8.2002e-013	3.0341e-008
Po-212	5.2657e-020	1.9483e-009	5.1655e-021	1.9112e-016
Po-213	3.5469e-006	1.3123e+005	3.4793e-007	1.2874e-002
Po-214	6.3255e-003	2.3404e+008	6.2051e-004	2.2959e+001
Po-215	3.0621e-009	1.1330e+002	3.0038e-010	1.1114e-005
Po-216	8.2253e-020	3.0434e-009	8.0688e-021	2.9854e-016
Po-218	6.3281e-003	2.3414e+008	6.2076e-004	2.2968e+001
Pr-144	2.3682e-005	8.7622e+005	2.3231e-006	8.5954e-002
Pr-144m	3.3864e-007	1.2530e+004	3.3220e-008	1.2291e-003
Pu-238	2.7318e-002	1.0108e+009	2.6798e-003	9.9154e+001
Pu-239	1.4997e-002	5.5491e+008	1.4712e-003	5.4434e+001
Pu-240	1.4991e-002	5.5465e+008	1.4705e-003	5.4409e+001
Ra-223	3.0621e-009	1.1330e+002	3.0038e-010	1.1114e-005
Ra-224	8.2254e-020	3.0434e-009	8.0688e-021	2.9854e-016
Ra-225	3.6433e-006	1.3480e+005	3.5740e-007	1.3224e-002
Ra-226	6.3280e-003	2.3414e+008	6.2076e-004	2.2968e+001
Ra-228	1.7999e-019	6.6596e-009	1.7656e-020	6.5328e-016
Rh-103m	1.5705e-024	5.8107e-014	1.5406e-025	5.7001e-021
Rh-106	1.1843e-004	4.3818e+006	1.1617e-005	4.2984e-001
Rn-219	3.0621e-009	1.1330e+002	3.0038e-010	1.1114e-005
Rn-220	8.2253e-020	3.0434e-009	8.0688e-021	2.9854e-016
Rn-222	6.3281e-003	2.3414e+008	6.2076e-004	2.2968e+001
Ru-103	1.5731e-024	5.8203e-014	1.5431e-025	5.7095e-021
Ru-106	1.1843e-004	4.3818e+006	1.1617e-005	4.2984e-001
Sb-125	1.5805e-003	5.8477e+007	1.5504e-004	5.7364e+000
Sr-90	3.8799e+001	1.4356e+012	3.8060e+000	1.4082e+005
Te-125m	3.8729e-004	1.4330e+007	3.7992e-005	1.4057e+000
Th-227	3.0523e-009	1.1294e+002	2.9942e-010	1.1079e-005
Th-228	8.2755e-020	3.0619e-009	8.1180e-021	3.0036e-016
Th-229	3.6702e-006	1.3580e+005	3.6003e-007	1.3321e-002
Th-230	3.5000e-007	1.2950e+004	3.4334e-008	1.2704e-003
Th-231	1.5900e-004	5.8830e+006	1.5597e-005	5.7710e-001
Th-232	7.0086e-019	2.5932e-008	6.8752e-020	2.5438e-015
Th-234	1.4900e-004	5.5130e+006	1.4616e-005	5.4080e-001
Tl-207	3.0537e-009	1.1299e+002	2.9955e-010	1.1083e-005

ENGINEERING DESIGN FILE

Page : 3
 DOS File : VTANK V-3 vessel 652gal decayed 8yr homog mix H2O no shiel
 Run Date: November 1, 2004
 Run Time: 10:57:50 AM
 Duration : 00:00:30

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Tl-208	2.9530e-020	1.0926e-009	2.8968e-021	1.0718e-016
Tl-209	7.8304e-008	2.8972e+003	7.6813e-009	2.8421e-004
U-233	4.8598e-003	1.7981e+008	4.7673e-004	1.7639e+001
U-234	4.8605e-003	1.7984e+008	4.7680e-004	1.7642e+001
U-235	1.5900e-004	5.8830e+006	1.5597e-005	5.7710e-001
U-236	3.5512e-009	1.3140e+002	3.4836e-010	1.2889e-005
U-238	1.4900e-004	5.5130e+006	1.4616e-005	5.4080e-001
Y-90	3.8809e+001	1.4359e+012	3.8070e+000	1.4086e+005
Zn-65	8.1562e-007	3.0178e+004	8.0009e-008	2.9603e-003
Zr-95	1.4607e-016	5.4047e-006	1.4329e-017	5.3018e-013

Buildup

The material reference is : Source

Integration Parameters

X Direction	21
Y Direction	21
Z Direction	21

Results - Dose Point # 1 - (1.22e+02,108,60) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>No Buildup</u>	<u>With Buildup</u>	<u>mR/hr</u>
0.015	1.130e+04	4.116e-193	1.679e-30	3.530e-194	1.441e-31
0.02	4.819e+07	4.800e-87	1.569e-26	1.663e-88	5.436e-28
0.03	2.837e+10	7.338e-27	5.943e-23	7.272e-29	5.890e-25
0.04	7.558e+09	3.538e-12	1.152e-10	1.565e-14	5.096e-13
0.05	2.265e+08	7.068e-08	3.718e-06	1.883e-10	9.905e-09
0.06	2.082e+08	3.502e-05	1.972e-03	6.955e-08	3.917e-06
0.08	9.553e+07	3.636e-03	1.424e-01	5.753e-06	2.254e-04
0.1	9.149e+08	3.055e-01	7.766e+00	4.674e-04	1.188e-02
0.15	1.658e+06	4.095e-03	5.173e-02	6.743e-06	8.518e-05
0.2	2.173e+08	1.189e+00	1.054e+01	2.099e-03	1.860e-02
0.3	3.344e+08	4.246e+00	2.584e+01	8.054e-03	4.901e-02
0.4	2.451e+08	5.272e+00	2.576e+01	1.027e-02	5.019e-02
0.5	1.974e+07	6.297e-01	2.629e+00	1.236e-03	5.161e-03
0.6	4.328e+11	1.897e+04	7.026e+04	3.703e+01	1.371e+02
0.8	7.964e+08	5.737e+01	1.782e+02	1.091e-01	3.390e-01
1.0	6.179e+09	6.533e+02	1.798e+03	1.204e+00	3.314e+00
1.5	6.070e+09	1.275e+03	2.873e+03	2.144e+00	4.834e+00
2.0	6.265e+07	2.102e+01	4.229e+01	3.250e-02	6.540e-02
3.0	1.090e-09	6.856e-16	1.200e-15	9.302e-19	1.628e-18
TOTALS:	4.841e+11	2.099e+04	7.522e+04	4.054e+01	1.458e+02

Results - Dose Point # 2 - (1.33e+02,108,60) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>No Buildup</u>	<u>With Buildup</u>	<u>mR/hr</u>
0.015	1.130e+04	3.913e-193	1.447e-30	3.356e-194	1.241e-31
0.02	4.819e+07	4.681e-87	1.352e-26	1.621e-88	4.683e-28
0.03	2.837e+10	7.256e-27	5.120e-23	7.191e-29	5.074e-25
0.04	7.558e+09	3.498e-12	1.139e-10	1.547e-14	5.038e-13
0.05	2.265e+08	6.904e-08	3.624e-06	1.839e-10	9.655e-09
0.06	2.082e+08	3.361e-05	1.882e-03	6.676e-08	3.739e-06
0.08	9.553e+07	3.382e-03	1.309e-01	5.352e-06	2.072e-04
0.1	9.149e+08	2.787e-01	6.984e+00	4.264e-04	1.069e-02
0.15	1.658e+06	3.663e-03	4.570e-02	6.033e-06	7.526e-05

ENGINEERING DESIGN FILE

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DOS File : VTANK V-3 vessel 652gal decayed 8yr homog mix H2O no shiel

Run Date: November 1, 2004

Run Time: 10:57:50 AM

Duration : 00:00:30

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>No Buildup</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>With Buildup</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.2	2.173e+08	1.058e+00	9.272e+00	1.867e-03	1.636e-02	
0.3	3.344e+08	3.758e+00	2.267e+01	7.129e-03	4.301e-02	
0.4	2.451e+08	4.657e+00	2.258e+01	9.074e-03	4.400e-02	
0.5	1.974e+07	5.556e-01	2.304e+00	1.091e-03	4.522e-03	
0.6	4.328e+11	1.672e+04	6.153e+04	3.264e+01	1.201e+02	
0.8	7.964e+08	5.050e+01	1.560e+02	9.605e-02	2.967e-01	
1.0	6.179e+09	5.743e+02	1.572e+03	1.059e+00	2.898e+00	
1.5	6.070e+09	1.118e+03	2.509e+03	1.882e+00	4.222e+00	
2.0	6.265e+07	1.842e+01	3.690e+01	2.848e-02	5.706e-02	
3.0	1.090e-09	5.998e-16	1.046e-15	8.138e-19	1.419e-18	
TOTALS:	4.841e+11	1.849e+04	6.586e+04	3.572e+01	1.277e+02	

Results - Dose Point # 3 - (1.45e+02,108,60) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>No Buildup</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>With Buildup</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.015	1.130e+04	3.694e-193	1.242e-30	3.168e-194	1.065e-31	
0.02	4.819e+07	4.557e-87	1.161e-26	1.578e-88	4.020e-28	
0.03	2.837e+10	7.166e-27	4.395e-23	7.102e-29	4.356e-25	
0.04	7.558e+09	3.446e-12	1.122e-10	1.524e-14	4.961e-13	
0.05	2.265e+08	6.692e-08	3.504e-06	1.783e-10	9.335e-09	
0.06	2.082e+08	3.194e-05	1.778e-03	6.345e-08	3.532e-06	
0.08	9.553e+07	3.111e-03	1.190e-01	4.923e-06	1.884e-04	
0.1	9.149e+08	2.516e-01	6.222e+00	3.849e-04	9.519e-03	
0.15	1.658e+06	3.248e-03	4.008e-02	5.348e-06	6.600e-05	
0.2	2.173e+08	9.324e-01	8.102e+00	1.646e-03	1.430e-02	
0.3	3.344e+08	3.301e+00	1.977e+01	6.261e-03	3.751e-02	
0.4	2.451e+08	4.083e+00	1.967e+01	7.956e-03	3.834e-02	
0.5	1.974e+07	4.866e-01	2.006e+00	9.551e-04	3.938e-03	
0.6	4.328e+11	1.463e+04	5.356e+04	2.856e+01	1.045e+02	
0.8	7.964e+08	4.414e+01	1.357e+02	8.395e-02	2.581e-01	
1.0	6.179e+09	5.016e+02	1.367e+03	9.245e-01	2.520e+00	
1.5	6.070e+09	9.751e+02	2.179e+03	1.641e+00	3.667e+00	
2.0	6.265e+07	1.604e+01	3.202e+01	2.481e-02	4.952e-02	
3.0	1.090e-09	5.217e-16	9.063e-16	7.078e-19	1.230e-18	
TOTALS:	4.841e+11	1.618e+04	5.733e+04	3.125e+01	1.111e+02	

Results - Dose Point # 4 - (1.57e+02,108,60) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>No Buildup</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>With Buildup</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.015	1.130e+04	3.485e-193	1.076e-30	2.989e-194	9.231e-32	
0.02	4.819e+07	4.436e-87	1.006e-26	1.537e-88	3.483e-28	
0.03	2.837e+10	7.076e-27	3.809e-23	7.013e-29	3.775e-25	
0.04	7.558e+09	3.383e-12	1.101e-10	1.496e-14	4.869e-13	
0.05	2.265e+08	6.453e-08	3.370e-06	1.719e-10	8.977e-09	
0.06	2.082e+08	3.020e-05	1.671e-03	5.998e-08	3.319e-06	
0.08	9.553e+07	2.852e-03	1.080e-01	4.514e-06	1.710e-04	
0.1	9.149e+08	2.269e-01	5.551e+00	3.471e-04	8.492e-03	
0.15	1.658e+06	2.885e-03	3.531e-02	4.751e-06	5.814e-05	
0.2	2.173e+08	8.246e-01	7.117e+00	1.455e-03	1.256e-02	
0.3	3.344e+08	2.910e+00	1.734e+01	5.520e-03	3.290e-02	
0.4	2.451e+08	3.595e+00	1.725e+01	7.005e-03	3.360e-02	
0.5	1.974e+07	4.281e-01	1.758e+00	8.404e-04	3.450e-03	

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK V-3 vessel 652gal decayed 8yr homog mix H2O no shiel
 Run Date: November 1, 2004
 Run Time: 10:57:50 AM
 Duration : 00:00:30

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>		<u>Exposure Rate</u>	
		<u>MeV/cm²/sec</u>	<u>No Buildup</u> <u>With Buildup</u>	<u>mR/hr</u>	<u>With Buildup</u>
0.6	4.328e+11	1.287e+04	4.691e+04	2.511e+01	9.157e+01
0.8	7.964e+08	3.878e+01	1.188e+02	7.375e-02	2.259e-01
1.0	6.179e+09	4.404e+02	1.196e+03	8.117e-01	2.205e+00
1.5	6.070e+09	8.551e+02	1.905e+03	1.439e+00	3.206e+00
2.0	6.265e+07	1.406e+01	2.798e+01	2.174e-02	4.327e-02
3.0	1.090e-09	4.567e-16	7.913e-16	6.196e-19	1.074e-18
TOTALS:	4.841e+11	1.422e+04	5.021e+04	2.747e+01	9.734e+01

Results - Dose Point # 5 - (1.69e+02,108,60) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>		<u>Exposure Rate</u>	
		<u>MeV/cm²/sec</u>	<u>No Buildup</u> <u>With Buildup</u>	<u>mR/hr</u>	<u>With Buildup</u>
0.015	1.130e+04	3.289e-193	9.404e-31	2.821e-194	8.066e-32
0.02	4.819e+07	4.318e-87	8.788e-27	1.496e-88	3.044e-28
0.03	2.837e+10	6.983e-27	3.328e-23	6.921e-29	3.298e-25
0.04	7.558e+09	3.311e-12	1.077e-10	1.464e-14	4.761e-13
0.05	2.265e+08	6.195e-08	3.226e-06	1.650e-10	8.594e-09
0.06	2.082e+08	2.842e-05	1.564e-03	5.646e-08	3.107e-06
0.08	9.553e+07	2.611e-03	9.801e-02	4.131e-06	1.551e-04
0.1	9.149e+08	2.047e-01	4.963e+00	3.132e-04	7.593e-03
0.15	1.658e+06	2.570e-03	3.125e-02	4.232e-06	5.146e-05
0.2	2.173e+08	7.319e-01	6.285e+00	1.292e-03	1.109e-02
0.3	3.344e+08	2.577e+00	1.530e+01	4.888e-03	2.902e-02
0.4	2.451e+08	3.180e+00	1.520e+01	6.196e-03	2.963e-02
0.5	1.974e+07	3.785e-01	1.549e+00	7.429e-04	3.041e-03
0.6	4.328e+11	1.137e+04	4.134e+04	2.219e+01	8.069e+01
0.8	7.964e+08	3.424e+01	1.046e+02	6.513e-02	1.990e-01
1.0	6.179e+09	3.887e+02	1.053e+03	7.165e-01	1.942e+00
1.5	6.070e+09	7.541e+02	1.677e+03	1.269e+00	2.821e+00
2.0	6.265e+07	1.239e+01	2.461e+01	1.916e-02	3.806e-02
3.0	1.090e-09	4.022e-16	6.956e-16	5.457e-19	9.437e-19
TOTALS:	4.841e+11	1.257e+04	4.424e+04	2.427e+01	8.577e+01

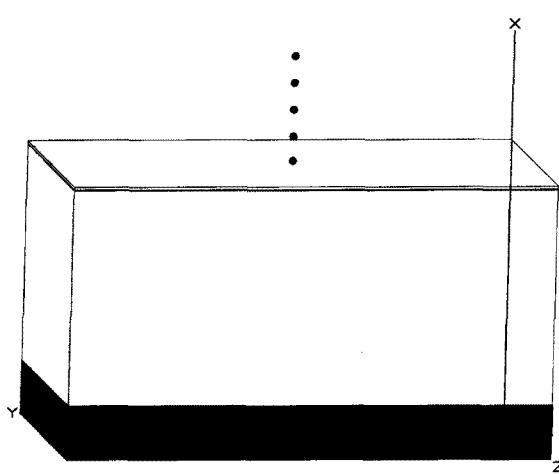
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
DOS File : VTANK V-3 vessel 652gal decayed 8yr homog mix H2O 1.25 in
Run Date: November 17, 2004
Run Time: 7:34:17 AM
Duration : 00:00:32

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: VTANK V-3 vessel
Description: 652 gal decayed 8 yr homog mix 1.25" Fe shield @cont, 1 to 4
Geometry: 13 - Rectangular Volume



Source Dimensions			
Length	60.96 cm	2 ft	
Width	304.8 cm	10 ft 0.0 in	
Height	548.64 cm	18 ft	

Dose Points			
# 1	X 312.0771 cm 10 ft 2.9 in	Y 274.32 cm 9 ft	Z 152.4 cm 5 ft 0.0 in
# 2	340.0171 cm 11 ft 1.9 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in
# 3	370.4971 cm 12 ft 1.9 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in
# 4	400.9771 cm 13 ft 1.9 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in
# 5	431.4571 cm 14 ft 1.9 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in

Shields			
Shield Name	Dimension	Material	Density
Source	6.22e+05 in ³	V123 SLUDGE	1.02
Shield 2	96.24 in	Air	0.00122
Shield 3	.375 in	Iron	7.86
Shield 4	1.25 in	Iron	7.86
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	3.6252e-006	1.3413e+005	3.5562e-007	1.3158e-002
Ac-227	3.1505e-009	1.1657e+002	3.0905e-010	1.1435e-005
Ac-228	1.7993e-019	6.6573e-009	1.7650e-020	6.5306e-016
Ag-108	1.8429e-004	6.8186e+006	1.8078e-005	6.6888e-001
Ag-108m	1.9816e-003	7.3318e+007	1.9438e-004	7.1922e+000
Ag-110	1.4842e-008	5.4917e+002	1.4560e-009	5.3871e-005
Ag-110m	1.1160e-006	4.1291e+004	1.0947e-007	4.0505e-003
Am-241	1.5401e-002	5.6984e+008	1.5108e-003	5.5899e+001
Am-243	7.1748e-009	2.6547e+002	7.0382e-010	2.6041e-005
At-217	3.6252e-006	1.3413e+005	3.5562e-007	1.3158e-002
Ba-137m	1.2988e+001	4.8057e+011	1.2741e+000	4.7142e+004
Bi-210	1.3917e-003	5.1494e+007	1.3652e-004	5.0514e+000
Bi-211	3.0620e-009	1.1330e+002	3.0037e-010	1.1114e-005
Bi-212	8.2187e-020	3.0409e-009	8.0622e-021	2.9830e-016
Bi-213	3.6252e-006	1.3413e+005	3.5562e-007	1.3158e-002
Bi-214	6.3268e-003	2.3409e+008	6.2064e-004	2.2964e+001
Ce-144	2.3681e-005	8.7619e+005	2.3230e-006	8.5951e-002
Cm-242	4.2798e-010	1.5835e+001	4.1983e-011	1.5534e-006
Cm-243	3.6056e-003	1.3341e+008	3.5369e-004	1.3087e+001
Cm-244	3.2247e-003	1.1932e+008	3.1634e-004	1.1704e+001
Co-58	1.3829e-015	5.1169e-005	1.3566e-016	5.0194e-012

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK V-3 vessel 652gal decayed 8yr homog mix H2O 1.25 in
Run Date: November 17, 2004
Run Time: 7:34:17 AM
Duration : 00:00:32

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Co-60	1.4249e-001	5.2720e+009	1.3977e-002	5.1717e+002
Cs-134	2.2418e-004	8.2947e+006	2.1991e-005	8.1368e-001
Cs-137	1.3730e+001	5.0800e+011	1.3468e+000	4.9833e+004
Eu-152	2.6473e-002	9.7951e+008	2.5969e-003	9.6086e+001
Eu-154	3.6424e-002	1.3477e+009	3.5731e-003	1.3220e+002
Eu-155	3.0634e-003	1.1335e+008	3.0051e-004	1.1119e+001
Fr-221	3.6252e-006	1.3413e+005	3.5562e-007	1.3158e-002
Fr-223	4.3476e-011	1.6086e+000	4.2648e-012	1.5780e-007
Gd-152	4.5805e-016	1.6948e-005	4.4933e-017	1.6625e-012
I-129	1.5300e-004	5.6610e+006	1.5009e-005	5.5532e-001
Mn-54	1.9998e-006	7.3994e+004	1.9618e-007	7.2585e-003
Nb-95	3.2292e-016	1.1948e-005	3.1677e-017	1.1720e-012
Nb-95m	1.2384e-018	4.5820e-008	1.2148e-019	4.4948e-015
Ni-63	1.9679e+000	7.2813e+010	1.9304e-001	7.1426e+003
Np-237	6.4640e-005	2.3917e+006	6.3409e-006	2.3461e-001
Np-239	7.1673e-009	2.6519e+002	7.0308e-010	2.6014e-005
Pa-231	2.6897e-008	9.9519e+002	2.6385e-009	9.7624e-005
Pa-233	6.4639e-005	2.3917e+006	6.3409e-006	2.3461e-001
Pa-234	2.3840e-007	8.8208e+003	2.3386e-008	8.6529e-004
Pa-234m	1.4900e-004	5.5130e+006	1.4616e-005	5.4080e-001
Pb-209	3.6249e-006	1.3412e+005	3.5559e-007	1.3157e-002
Pb-210	1.3948e-003	5.1607e+007	1.3682e-004	5.0624e+000
Pb-211	3.0620e-009	1.1330e+002	3.0037e-010	1.1114e-005
Pb-212	8.2193e-020	3.0411e-009	8.0628e-021	2.9833e-016
Pb-214	6.3268e-003	2.3409e+008	6.2064e-004	2.2964e+001
Po-210	1.3063e-003	4.8332e+007	1.2814e-004	4.7412e+000
Po-211	8.3593e-012	3.0930e-001	8.2002e-013	3.0341e-008
Po-212	5.2657e-020	1.9483e-009	5.1655e-021	1.9112e-016
Po-213	3.5469e-006	1.3123e+005	3.4793e-007	1.2874e-002
Po-214	6.3255e-003	2.3404e+008	6.2051e-004	2.2959e+001
Po-215	3.0621e-009	1.1330e+002	3.0038e-010	1.1114e-005
Po-216	8.2253e-020	3.0434e-009	8.0688e-021	2.9854e-016
Po-218	6.3281e-003	2.3414e+008	6.2076e-004	2.2968e+001
Pr-144	2.3682e-005	8.7622e+005	2.3231e-006	8.5954e-002
Pr-144m	3.3864e-007	1.2530e+004	3.3220e-008	1.2291e-003
Pu-238	2.7318e-002	1.0108e+009	2.6798e-003	9.9154e+001
Pu-239	1.4997e-002	5.5491e+008	1.4712e-003	5.4434e+001
Pu-240	1.4991e-002	5.5465e+008	1.4705e-003	5.4409e+001
Ra-223	3.0621e-009	1.1330e+002	3.0038e-010	1.1114e-005
Ra-224	8.2254e-020	3.0434e-009	8.0688e-021	2.9854e-016
Ra-225	3.6433e-006	1.3480e+005	3.5740e-007	1.3224e-002
Ra-226	6.3280e-003	2.3414e+008	6.2076e-004	2.2968e+001
Ra-228	1.7999e-019	6.6596e-009	1.7656e-020	6.5328e-016
Rh-103m	1.5705e-024	5.8107e-014	1.5406e-025	5.7001e-021
Rh-106	1.1843e-004	4.3818e+006	1.1617e-005	4.2984e-001
Rn-219	3.0621e-009	1.1330e+002	3.0038e-010	1.1114e-005
Rn-220	8.2253e-020	3.0434e-009	8.0688e-021	2.9854e-016
Rn-222	6.3281e-003	2.3414e+008	6.2076e-004	2.2968e+001
Ru-103	1.5731e-024	5.8203e-014	1.5431e-025	5.7095e-021
Ru-106	1.1843e-004	4.3818e+006	1.1617e-005	4.2984e-001
Sb-125	1.5805e-003	5.8477e+007	1.5504e-004	5.7364e+000
Sr-90	3.8799e+001	1.4356e+012	3.8060e+000	1.4082e+005
Te-125m	3.8729e-004	1.4330e+007	3.7992e-005	1.4057e+000
Th-227	3.0523e-009	1.1294e+002	2.9942e-010	1.1079e-005
Th-228	8.2755e-020	3.0619e-009	8.1180e-021	3.0036e-016
Th-229	3.6702e-006	1.3580e+005	3.6003e-007	1.3321e-002
Th-230	3.5000e-007	1.2950e+004	3.4334e-008	1.2704e-003
Th-231	1.5900e-004	5.8830e+006	1.5597e-005	5.7710e-001
Th-232	7.0086e-019	2.5932e-008	6.8752e-020	2.5438e-015
Th-234	1.4900e-004	5.5130e+006	1.4616e-005	5.4080e-001

ENGINEERING DESIGN FILE

Page : 3
 DOS File : VTANK V-3 vessel 652gal decayed 8yr homog mix H2O 1.25 in
 Run Date: November 17, 2004
 Run Time: 7:34:17 AM
 Duration : 00:00:32

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
TI-207	3.0537e-009	1.1299e+002	2.9955e-010	1.1083e-005
TI-208	2.9530e-020	1.0926e-009	2.8968e-021	1.0718e-016
TI-209	7.8304e-008	2.8972e+003	7.6813e-009	2.8421e-004
U-233	4.8598e-003	1.7981e+008	4.7673e-004	1.7639e+001
U-234	4.8605e-003	1.7984e+008	4.7680e-004	1.7642e+001
U-235	1.5900e-004	5.8830e+006	1.5597e-005	5.7710e-001
U-236	3.5512e-009	1.3140e+002	3.4836e-010	1.2889e-005
U-238	1.4900e-004	5.5130e+006	1.4616e-005	5.4080e-001
Y-90	3.8809e+001	1.4359e+012	3.8070e+000	1.4086e+005
Zn-65	8.1562e-007	3.0178e+004	8.0009e-008	2.9603e-003
Zr-95	1.4607e-016	5.4047e-006	1.4329e-017	5.3018e-013

Buildup
The material reference is : Shield 4

Integration Parameters

X Direction	21
Y Direction	21
Z Direction	21

Results - Dose Point # 1 - (122.865,108,60) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
0.015	1.130e+04	0.000e+00	1.116e-30	0.000e+00	9.575e-32
0.02	4.819e+07	0.000e+00	7.482e-27	0.000e+00	2.592e-28
0.03	2.837e+10	1.973e-113	6.048e-24	1.956e-115	5.994e-26
0.04	7.558e+09	1.748e-50	2.464e-24	7.729e-53	1.090e-26
0.05	2.265e+08	1.482e-28	1.056e-25	3.947e-31	2.812e-28
0.06	2.082e+08	5.545e-18	9.173e-18	1.101e-20	1.822e-20
0.08	9.553e+07	1.407e-09	3.115e-09	2.226e-12	4.929e-12
0.1	9.149e+08	2.614e-05	7.466e-05	3.998e-08	1.142e-07
0.15	1.658e+06	2.430e-05	1.051e-04	4.001e-08	1.730e-07
0.2	2.173e+08	2.376e-02	1.343e-01	4.194e-05	2.371e-04
0.3	3.344e+08	2.044e-01	1.339e+00	3.878e-04	2.540e-03
0.4	2.451e+08	3.789e-01	2.465e+00	7.383e-04	4.803e-03
0.5	1.974e+07	5.852e-02	3.563e-01	1.149e-04	6.994e-04
0.6	4.328e+11	2.128e+03	1.197e+04	4.154e+00	2.337e+01
0.8	7.964e+08	8.451e+00	4.073e+01	1.608e-02	7.747e-02
1.0	6.179e+09	1.169e+02	4.926e+02	2.154e-01	9.080e-01
1.5	6.070e+09	3.111e+02	1.025e+03	5.234e-01	1.724e+00
2.0	6.265e+07	6.105e+00	1.737e+01	9.441e-03	2.686e-02
3.0	1.090e-09	2.390e-16	5.623e-16	3.242e-19	7.629e-19
TOTALS:	4.841e+11	2.571e+03	1.355e+04	4.920e+00	2.612e+01

Results - Dose Point # 2 - (133.865,108,60) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
0.015	1.130e+04	0.000e+00	9.627e-31	0.000e+00	8.257e-32
0.02	4.819e+07	0.000e+00	6.452e-27	0.000e+00	2.235e-28
0.03	2.837e+10	1.949e-113	5.216e-24	1.931e-115	5.169e-26
0.04	7.558e+09	1.734e-50	2.125e-24	7.669e-53	9.397e-27
0.05	2.265e+08	1.472e-28	9.103e-26	3.921e-31	2.425e-28
0.06	2.082e+08	5.505e-18	9.108e-18	1.094e-20	1.809e-20
0.08	9.553e+07	1.384e-09	3.064e-09	2.190e-12	4.849e-12
0.1	9.149e+08	2.535e-05	7.236e-05	3.878e-08	1.107e-07

ENGINEERING DESIGN FILE

age : 4
 DOS File : VTANK V-3 vessel 652gal decayed 8yr homog mix H2O 1.25 in
 Run Date: November 17, 2004
 Run Time: 7:34:17 AM
 Duration : 00:00:32

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.15	1.658e+06	2.297e-05	9.898e-05	3.783e-08	1.630e-07
0.2	2.173e+08	2.219e-02	1.247e-01	3.916e-05	2.201e-04
0.3	3.344e+08	1.888e-01	1.226e+00	3.582e-04	2.326e-03
0.4	2.451e+08	3.480e-01	2.242e+00	6.781e-04	4.369e-03
0.5	1.974e+07	5.353e-02	3.227e-01	1.051e-04	6.334e-04
0.6	4.328e+11	1.941e+03	1.081e+04	3.789e+00	2.110e+01
0.8	7.964e+08	7.672e+00	3.660e+01	1.459e-02	6.962e-02
1.0	6.179e+09	1.057e+02	4.413e+02	1.948e-01	8.134e-01
1.5	6.070e+09	2.796e+02	9.132e+02	4.705e-01	1.537e+00
2.0	6.265e+07	5.468e+00	1.543e+01	8.455e-03	2.385e-02
3.0	1.090e-09	2.131e-16	4.978e-16	2.891e-19	6.753e-19
TOTALS:	4.841e+11	2.340e+03	1.222e+04	4.478e+00	2.355e+01

Results - Dose Point # 3 - (145,865,108,60) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.130e+04	0.000e+00	8.272e-31	0.000e+00	7.095e-32
0.02	4.819e+07	0.000e+00	5.544e-27	0.000e+00	1.921e-28
0.03	2.837e+10	1.924e-113	4.482e-24	1.907e-115	4.442e-26
0.04	7.558e+09	1.719e-50	1.826e-24	7.602e-53	8.075e-27
0.05	2.265e+08	1.461e-28	7.823e-26	3.891e-31	2.084e-28
0.06	2.082e+08	5.457e-18	9.027e-18	1.084e-20	1.793e-20
0.08	9.553e+07	1.353e-09	2.996e-09	2.142e-12	4.740e-12
0.1	9.149e+08	2.438e-05	6.951e-05	3.729e-08	1.063e-07
0.15	1.658e+06	2.149e-05	9.226e-05	3.538e-08	1.519e-07
0.2	2.173e+08	2.050e-02	1.145e-01	3.618e-05	2.021e-04
0.3	3.344e+08	1.726e-01	1.112e+00	3.273e-04	2.109e-03
0.4	2.451e+08	3.163e-01	2.020e+00	6.163e-04	3.935e-03
0.5	1.974e+07	4.848e-02	2.895e-01	9.516e-05	5.682e-04
0.6	4.328e+11	1.753e+03	9.668e+03	3.421e+00	1.887e+01
0.8	7.964e+08	6.898e+00	3.260e+01	1.312e-02	6.202e-02
1.0	6.179e+09	9.473e-01	3.920e+02	1.746e-01	7.225e-01
1.5	6.070e+09	2.492e+02	8.074e+02	4.193e-01	1.358e+00
2.0	6.265e+07	4.856e+00	1.360e+01	7.510e-03	2.103e-02
3.0	1.090e-09	1.885e-16	4.376e-16	2.558e-19	5.937e-19
TOTALS:	4.841e+11	2.109e+03	1.092e+04	4.037e+00	2.104e+01

Results - Dose Point # 4 - (157,865,108,60) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.130e+04	0.000e+00	7.175e-31	0.000e+00	6.154e-32
0.02	4.819e+07	0.000e+00	4.809e-27	0.000e+00	1.666e-28
0.03	2.837e+10	1.901e-113	3.887e-24	1.884e-115	3.852e-26
0.04	7.558e+09	1.704e-50	1.584e-24	7.537e-53	7.004e-27
0.05	2.265e+08	1.449e-28	6.785e-26	3.861e-31	1.807e-28
0.06	2.082e+08	5.399e-18	8.931e-18	1.072e-20	1.774e-20
0.08	9.553e+07	1.318e-09	2.915e-09	2.085e-12	4.613e-12
0.1	9.149e+08	2.332e-05	6.643e-05	3.567e-08	1.016e-07
0.15	1.658e+06	2.001e-05	8.565e-05	3.295e-08	1.410e-07
0.2	2.173e+08	1.887e-02	1.049e-01	3.331e-05	1.851e-04
0.3	3.344e+08	1.574e-01	1.007e+00	2.985e-04	1.910e-03
0.4	2.451e+08	2.872e-01	1.819e+00	5.595e-04	3.545e-03

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK V-3 vessel 652gal decayed 8yr homog mix H2O 1.25 in
 Run Date: November 17, 2004
 Run Time: 7:34:17 AM
 Duration : 00:00:32

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>		<u>Exposure Rate</u> <u>mR/hr</u>	
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.5	1.974e+07	4.387e-02	2.599e-01	8.611e-05	5.101e-04
0.6	4.328e+11	1.582e+03	8.658e+03	3.088e+00	1.690e+01
0.8	7.964e+08	6.205e+00	2.910e+01	1.180e-02	5.536e-02
1.0	6.179e+09	8.498e+01	3.491e+02	1.566e-01	6.434e-01
1.5	6.070e+09	2.225e+02	7.163e+02	3.744e-01	1.205e+00
2.0	6.265e+07	4.325e+00	1.204e+01	6.687e-03	1.862e-02
3.0	1.090e-09	1.673e-16	3.864e-16	2.270e-19	5.243e-19
TOTALS:	4.841e+11	1.901e+03	9.768e+03	3.639e+00	1.883e+01

Results - Dose Point # 5 - (169.865,108,60) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>		<u>Exposure Rate</u> <u>mR/hr</u>	
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.130e+04	0.000e+00	6.275e-31	0.000e+00	5.382e-32
0.02	4.819e+07	0.000e+00	4.205e-27	0.000e+00	1.457e-28
0.03	2.837e+10	1.878e-113	3.400e-24	1.862e-115	3.369e-26
0.04	7.558e+09	1.689e-50	1.385e-24	7.472e-53	6.125e-27
0.05	2.265e+08	1.437e-28	5.934e-26	3.828e-31	1.581e-28
0.06	2.082e+08	5.329e-18	8.816e-18	1.059e-20	1.751e-20
0.08	9.553e+07	1.277e-09	2.825e-09	2.021e-12	4.470e-12
0.1	9.149e+08	2.221e-05	6.321e-05	3.397e-08	9.670e-08
0.15	1.658e+06	1.858e-05	7.929e-05	3.059e-08	1.306e-07
0.2	2.173e+08	1.734e-02	9.595e-02	3.061e-05	1.694e-04
0.3	3.344e+08	1.434e-01	9.120e-01	2.721e-04	1.730e-03
0.4	2.451e+08	2.606e-01	1.640e+00	5.079e-04	3.196e-03
0.5	1.974e+07	3.971e-02	2.337e-01	7.795e-05	4.587e-04
0.6	4.328e+11	1.430e+03	7.771e+03	2.790e+00	1.517e+01
0.8	7.964e+08	5.589e+00	2.605e+01	1.063e-02	4.954e-02
1.0	6.179e+09	7.638e+01	3.118e+02	1.408e-01	5.748e-01
1.5	6.070e+09	1.993e+02	6.379e+02	3.352e-01	1.073e+00
2.0	6.265e+07	3.863e+00	1.070e+01	5.974e-03	1.655e-02
3.0	1.090e-09	1.491e-16	3.429e-16	2.023e-19	4.652e-19
TOTALS:	4.841e+11	1.715e+03	8.760e+03	3.284e+00	1.689e+01

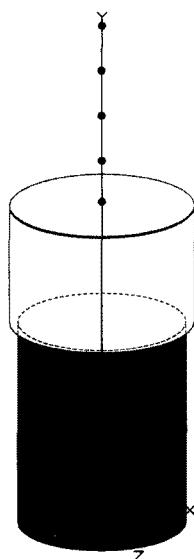
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK V-9 vessel 320 gal decayed 8yr no shield.ms6
 Run Date: November 16, 2004
 Run Time: 3:39:09 PM
 Duration : 00:00:02

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: Vtank 9 Ext Exposure
Description: 320 gal batch decayed 8 yrs w/o shield@ cont., 1, 2, 3, 4 ft
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions		
Height	135.331 cm	4 ft 5.3 in
Radius	53.34 cm	1 ft 9.0 in

Dose Points		
#	X	Y
# 1	0 cm	216.5477 cm
	0.0 in	7 ft 1.3 in
# 2	0 cm	244.4877 cm
	0.0 in	8 ft 0.3 in
# 3	0 cm	274.9677 cm
	0.0 in	9 ft 0.3 in
# 4	0 cm	305.4477 cm
	0.0 in	10 ft 0.3 in
# 5	0 cm	335.9277 cm
	0.0 in	11 ft 0.3 in

Shields			
Shield Name	Dimension	Material	Density
Source	7.38e+04 in ³	V123 SLUDGE	1.02
Shield 1	30.6 in	Air	0.00122
Shield 2	.375 in	Iron	7.86
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	8.5036e-006	3.1463e+005	7.0299e-006	2.6011e-001
Ac-227	7.4304e-009	2.7492e+002	6.1427e-009	2.2728e-004
Ac-228	9.2959e-020	3.4395e-009	7.6849e-020	2.8434e-015
Am-241	5.2621e-003	1.9470e+008	4.3501e-003	1.6095e+002
Am-243	1.0091e-009	3.7335e+001	8.3419e-010	3.0865e-005
At-217	8.5036e-006	3.1463e+005	7.0299e-006	2.6011e-001
Ba-137m	4.6837e+000	1.7330e+011	3.8720e+000	1.4326e+005
Bi-210	1.0956e-010	4.0538e+000	9.0575e-011	3.3513e-006
Bi-211	7.2218e-009	2.6721e+002	5.9702e-009	2.2090e-004
Bi-212	4.2462e-020	1.5711e-009	3.5103e-020	1.2988e-015
Bi-213	8.5035e-006	3.1463e+005	7.0298e-006	2.6010e-001
Bi-214	1.4153e-009	5.2366e+001	1.1700e-009	4.3291e-005
Cm-243	5.0709e-004	1.8762e+007	4.1921e-004	1.5511e+001
Cm-244	4.5353e-004	1.6780e+007	3.7493e-004	1.3872e+001
Co-60	3.4923e-001	1.2922e+010	2.8871e-001	1.0682e+004
Cs-137	4.9510e+000	1.8319e+011	4.0930e+000	1.5144e+005
Eu-154	1.2567e-002	4.6500e+008	1.0389e-002	3.8441e+002
Fr-221	8.5036e-006	3.1463e+005	7.0299e-006	2.6011e-001
Fr-223	1.0254e-010	3.7939e+000	8.4768e-011	3.1364e-006
Np-237	3.2014e-005	1.1845e+006	2.6466e-005	9.7923e-001
Np-239	1.0080e-009	3.7296e+001	8.3331e-010	3.0832e-005
Pa-231	6.3436e-008	2.3471e+003	5.2443e-008	1.9404e-003
Pa-233	3.2013e-005	1.1845e+006	2.6465e-005	9.7922e-001

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK V-9 vessel 320 gal decayed 8yr no shield.ms6
Run Date: November 16, 2004
Run Time: 3:39:09 PM
Duration : 00:00:02

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Pa-234	1.3680e-007	5.0616e+003	1.1309e-007	4.1844e-003
Pa-234m	8.5500e-005	3.1635e+006	7.0683e-005	2.6153e+000
Pb-209	8.5029e-006	3.1461e+005	7.0293e-006	2.6008e-001
Pb-210	1.1036e-010	4.0834e+000	9.1236e-011	3.3757e-006
Pb-211	7.2218e-009	2.6721e+002	5.9702e-009	2.2090e-004
Pb-212	4.2465e-020	1.5712e-009	3.5106e-020	1.2989e-015
Pb-214	1.4153e-009	5.2366e+001	1.1700e-009	4.3291e-005
Po-210	9.0195e-011	3.3372e+000	7.4564e-011	2.7589e-006
Po-211	1.9715e-011	7.2947e-001	1.6299e-011	6.0305e-007
Po-212	2.7205e-020	1.0066e-009	2.2490e-020	8.3214e-016
Po-213	8.3198e-006	3.0783e+005	6.8780e-006	2.5448e-001
Po-214	1.4150e-009	5.2355e+001	1.1698e-009	4.3281e-005
Po-215	7.2220e-009	2.6721e+002	5.9704e-009	2.2090e-004
Po-216	4.2496e-020	1.5724e-009	3.5131e-020	1.2999e-015
Po-218	1.4156e-009	5.2378e+001	1.1703e-009	4.3301e-005
Pu-238	2.0090e-002	7.4331e+008	1.6608e-002	6.1449e+002
Pu-239	7.7483e-003	2.8669e+008	6.4055e-003	2.3700e+002
Pu-240	7.7439e-003	2.8652e+008	6.4019e-003	2.3687e+002
Ra-223	7.2220e-009	2.6721e+002	5.9704e-009	2.2090e-004
Ra-224	4.2496e-020	1.5724e-009	3.5131e-020	1.2999e-015
Ra-225	8.5461e-006	3.1621e+005	7.0650e-006	2.6141e-001
Ra-226	1.4210e-009	5.2576e+001	1.1747e-009	4.3464e-005
Ra-228	9.2991e-020	3.4407e-009	7.6875e-020	2.8444e-015
Rn-219	7.2220e-009	2.6721e+002	5.9704e-009	2.2090e-004
Rn-220	4.2496e-020	1.5724e-009	3.5131e-020	1.2999e-015
Rn-222	1.4156e-009	5.2378e+001	1.1703e-009	4.3301e-005
Sr-90	5.6180e+000	2.0787e+011	4.6444e+000	1.7184e+005
Th-227	7.1989e-009	2.6636e+002	5.9513e-009	2.2020e-004
Th-228	4.2755e-020	1.5819e-009	3.5346e-020	1.3078e-015
Th-229	8.6090e-006	3.1853e+005	7.1170e-006	2.6333e-001
Th-230	8.2095e-007	3.0375e+004	6.7868e-007	2.5111e-002
Th-231	3.7500e-004	1.3875e+007	3.1001e-004	1.1470e+001
Th-232	3.6209e-019	1.3397e-008	2.9934e-019	1.1076e-014
Th-234	8.5500e-005	3.1635e+006	7.0683e-005	2.6153e+000
Tl-207	7.2020e-009	2.6648e+002	5.9539e-009	2.2029e-004
Tl-208	1.5257e-020	5.6449e-010	1.2613e-020	4.6666e-016
Tl-209	1.8367e-007	6.7960e+003	1.5184e-007	5.6182e-003
U-233	1.1400e-002	4.2179e+008	9.4240e-003	3.4869e+002
U-234	1.1400e-002	4.2181e+008	9.4245e-003	3.4871e+002
U-235	3.7500e-004	1.3875e+007	3.1001e-004	1.1470e+001
U-236	1.8346e-009	6.7882e+001	1.5167e-009	5.6118e-005
U-238	8.5500e-005	3.1635e+006	7.0683e-005	2.6153e+000
Y-90	5.6194e+000	2.0792e+011	4.6456e+000	1.7189e+005

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (0,85,255,0) in

<u>Energy MeV</u>	<u>Activity photons/sec</u>	<u>Fluence Rate MeV/cm²/sec</u>	<u>Fluence Rate MeV/cm²/sec</u>	<u>Exposure Rate mR/hr</u>	<u>Exposure Rate mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	2.367e-187	1.723e-24	2.030e-188	1.477e-25
0.02	8.777e+00	6.709e-93	1.549e-32	2.324e-94	5.367e-34

ENGINEERING DESIGN FILE

Page : 3
DOS File : VTANK V-9 vessel 320 gal decayed 8yr no shield.ms6
Run Date: November 16, 2004
Run Time: 3:39:09 PM
Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
			<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.03	1.021e+10	2.380e-26	1.160e-22	2.359e-28	1.150e-24
0.04	2.504e+09	1.034e-11	3.360e-10	4.572e-14	1.486e-12
0.05	2.469e+07	6.557e-08	3.409e-06	1.747e-10	9.081e-09
0.06	7.085e+07	9.493e-05	5.175e-03	1.885e-07	1.028e-05
0.08	2.004e+06	5.307e-04	1.927e-02	8.398e-07	3.049e-05
0.1	2.005e+08	4.270e-01	9.784e+00	6.532e-04	1.497e-02
0.15	2.272e+06	3.258e-02	3.631e-01	5.365e-05	5.980e-04
0.2	4.300e+07	1.319e+00	1.028e+01	2.328e-03	1.815e-02
0.3	3.374e+06	2.318e-01	1.248e+00	4.396e-04	2.367e-03
0.4	3.448e+06	3.926e-01	1.710e+00	7.650e-04	3.332e-03
0.5	1.014e+06	1.686e-01	6.320e-01	3.309e-04	1.241e-03
0.6	1.560e+11	3.515e+04	1.177e+05	6.861e+01	2.298e+02
0.8	1.813e+08	6.579e+01	1.871e+02	1.251e-01	3.558e-01
1.0	1.306e+10	6.845e+03	1.744e+04	1.262e+01	3.215e+01
1.5	1.310e+10	1.328e+04	2.829e+04	2.234e+01	4.759e+01
2.0	1.054e+02	1.680e-04	3.242e-04	2.598e-07	5.013e-07
3.0	5.634e-10	1.659e-15	2.836e-15	2.251e-18	3.848e-18
TOTALS:	1.975e+11	5.534e+04	1.637e+05	1.037e+02	3.100e+02

Results - Dose Point # 2 - (0,96.255,0) in					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
			<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	2.247e-187	1.174e-24	1.927e-188	1.007e-25
0.02	8.777e+00	6.552e-93	1.056e-32	2.270e-94	3.659e-34
0.03	1.021e+10	2.351e-26	7.910e-23	2.330e-28	7.839e-25
0.04	2.504e+09	9.832e-12	3.182e-10	4.349e-14	1.407e-12
0.05	2.469e+07	5.633e-08	2.881e-06	1.501e-10	7.675e-09
0.06	7.085e+07	7.429e-05	3.942e-03	1.476e-07	7.830e-06
0.08	2.004e+06	3.740e-04	1.315e-02	5.918e-07	2.081e-05
0.1	2.005e+08	2.879e-01	6.415e+00	4.405e-04	9.815e-03
0.15	2.272e+06	2.123e-02	2.331e-01	3.496e-05	3.839e-04
0.2	4.300e+07	8.516e-01	6.587e+00	1.503e-03	1.163e-02
0.3	3.374e+06	1.489e-01	8.002e-01	2.824e-04	1.518e-03
0.4	3.448e+06	2.519e-01	1.098e+00	4.907e-04	2.140e-03
0.5	1.014e+06	1.081e-01	4.065e-01	2.122e-04	7.979e-04
0.6	1.560e+11	2.254e+04	7.583e+04	4.399e+01	1.480e+02
0.8	1.813e+08	4.220e+01	1.207e+02	8.027e-02	2.297e-01
1.0	1.306e+10	4.395e+03	1.128e+04	8.101e+00	2.079e+01
1.5	1.310e+10	8.545e+03	1.837e+04	1.438e+01	3.091e+01
2.0	1.054e+02	1.084e-04	2.112e-04	1.677e-07	3.267e-07
3.0	5.634e-10	1.076e-15	1.857e-15	1.459e-18	2.520e-18
TOTALS:	1.975e+11	3.552e+04	1.056e+05	6.655e+01	2.000e+02

Results - Dose Point # 3 - (0,108.255,0) in					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
			<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	2.123e-187	8.331e-25	1.821e-188	7.146e-26
0.02	8.777e+00	6.394e-93	7.494e-33	2.215e-94	2.596e-34
0.03	1.021e+10	2.293e-26	5.611e-23	2.272e-28	5.561e-25
0.04	2.504e+09	8.736e-12	2.811e-10	3.863e-14	1.243e-12
0.05	2.469e+07	4.498e-08	2.270e-06	1.198e-10	6.046e-09
0.06	7.085e+07	5.536e-05	2.887e-03	1.100e-07	5.733e-06

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK V-9 vessel 320 gal decayed 8yr no shield.ms6
 Run Date: November 16, 2004
 Run Time: 3:39:09 PM
 Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.08	2.004e+06	2.612e-04	9.028e-03	4.133e-07	1.429e-05
0.1	2.005e+08	1.962e-01	4.317e+00	3.002e-04	6.604e-03
0.15	2.272e+06	1.421e-02	1.556e-01	2.340e-05	2.562e-04
0.2	4.300e+07	5.677e-01	4.398e+00	1.002e-03	7.763e-03
0.3	3.374e+06	9.910e-02	5.355e-01	1.880e-04	1.016e-03
0.4	3.448e+06	1.676e-01	7.362e-01	3.266e-04	1.434e-03
0.5	1.014e+06	7.199e-02	2.729e-01	1.413e-04	5.357e-04
0.6	1.560e+11	1.502e+04	5.097e+04	2.932e+01	9.949e+01
0.8	1.813e+08	2.817e+01	8.136e+01	5.357e-02	1.547e-01
1.0	1.306e+10	2.937e+03	7.615e+03	5.414e+00	1.404e+01
1.5	1.310e+10	5.732e+03	1.245e+04	9.643e+00	2.095e+01
2.0	1.054e+02	7.295e-05	1.436e-04	1.128e-07	2.221e-07
3.0	5.634e-10	7.273e-16	1.268e-15	9.867e-19	1.721e-18
TOTALS:	1.975e+11	2.372e+04	7.113e+04	4.443e+01	1.346e+02

Results - Dose Point # 4 - (0,120.255,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	2.007e-187	6.250e-25	1.722e-188	5.361e-26
0.02	8.777e+00	6.252e-93	5.622e-33	2.166e-94	1.947e-34
0.03	1.021e+10	2.173e-26	4.209e-23	2.153e-28	4.172e-25
0.04	2.504e+09	7.424e-12	2.377e-10	3.283e-14	1.051e-12
0.05	2.469e+07	3.533e-08	1.768e-06	9.413e-11	4.709e-09
0.06	7.085e+07	4.165e-05	2.150e-03	8.274e-08	4.271e-06
0.08	2.004e+06	1.893e-04	6.491e-03	2.996e-07	1.027e-05
0.1	2.005e+08	1.404e-01	3.074e+00	2.148e-04	4.702e-03
0.15	2.272e+06	1.007e-02	1.105e-01	1.659e-05	1.820e-04
0.2	4.300e+07	4.017e-01	3.128e+00	7.091e-04	5.521e-03
0.3	3.374e+06	7.013e-02	3.816e-01	1.330e-04	7.239e-04
0.4	3.448e+06	1.187e-01	5.255e-01	2.313e-04	1.024e-03
0.5	1.014e+06	5.102e-02	1.951e-01	1.001e-04	3.829e-04
0.6	1.560e+11	1.065e+04	3.647e+04	2.080e+01	7.119e+01
0.8	1.813e+08	2.001e+01	5.833e+01	3.806e-02	1.109e-01
1.0	1.306e+10	2.090e+03	5.468e+03	3.852e+00	1.008e+01
1.5	1.310e+10	4.091e+03	8.972e+03	6.884e+00	1.510e+01
2.0	1.054e+02	5.222e-05	1.038e-04	8.075e-08	1.604e-07
3.0	5.634e-10	5.229e-16	9.198e-16	7.094e-19	1.248e-18
TOTALS:	1.975e+11	1.686e+04	5.098e+04	3.157e+01	9.649e+01

Results - Dose Point # 5 - (0,132.255,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	1.902e-187	4.834e-25	1.631e-188	4.146e-26
0.02	8.777e+00	6.129e-93	4.348e-33	2.123e-94	1.506e-34
0.03	1.021e+10	1.996e-26	3.255e-23	1.978e-28	3.226e-25
0.04	2.504e+09	6.190e-12	1.975e-10	2.738e-14	8.733e-13
0.05	2.469e+07	2.790e-08	1.388e-06	7.432e-11	3.698e-09
0.06	7.085e+07	3.200e-05	1.642e-03	6.356e-08	3.262e-06
0.08	2.004e+06	1.422e-04	4.856e-03	2.250e-07	7.684e-06
0.1	2.005e+08	1.046e-01	2.288e+00	1.600e-04	3.500e-03
0.15	2.272e+06	7.469e-03	8.227e-02	1.230e-05	1.355e-04
0.2	4.300e+07	2.977e-01	2.332e+00	5.255e-04	4.115e-03

ENGINEERING DESIGN FILE

Page : 5
DOS File : VTANK V-9 vessel 320 gal decayed 8yr no shield.ms6
Run Date: November 16, 2004
Run Time: 3:39:09 PM
Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		<u>MeV/cm²/sec</u>	<u>No Buildup</u> <u>With Buildup</u>	<u>mR/hr</u> <u>No Buildup</u> <u>With Buildup</u>	<u>mR/hr</u>
0.3	3.374e+06	5.200e-02	2.850e-01 3.930e-01	9.863e-05 1.717e-04	5.407e-04 7.658e-04
0.4	3.448e+06	8.810e-02	3.789e-02 1.460e-01	7.438e-05 1.546e+01	2.866e-04 5.335e+01
0.5	1.014e+06	3.789e-02	1.460e-01	7.438e-05	2.866e-04
0.6	1.560e+11	7.920e+03	2.733e+04	1.546e+01	5.335e+01
0.8	1.813e+08	1.490e+01	4.378e+01	2.833e-02	8.327e-02
1.0	1.306e+10	1.558e+03	4.109e+03	2.872e+00	7.575e+00
1.5	1.310e+10	3.059e+03	6.761e+03	5.146e+00	1.138e+01
2.0	1.054e+02	3.913e-05	7.835e-05	6.051e-08	1.212e-07
3.0	5.634e-10	3.932e-16	6.966e-16	5.335e-19	9.451e-19
TOTALS:	1.975e+11	1.255e+04	3.825e+04	2.351e+01	7.239e+01

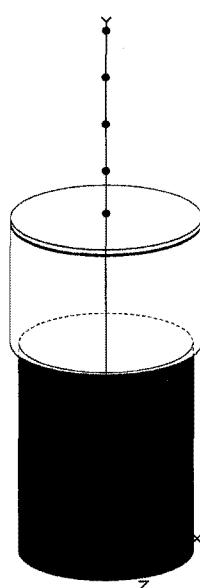
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK V-9 vessel 320 gal decayed 8yr 1.25 in Fe shield.ms6
 Run Date: November 16, 2004
 Run Time: 3:45:23 PM
 Duration : 00:00:02

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: Vtank 9 Ext Exposure
Description: 320 gal batch decayed 8 yrs w/shield @ cont., 1, 2, 3, 4 ft
Geometry: 8 - Cylinder Volume - End Shields



		Source Dimensions
		Height Radius
		135.331 cm 53.34 cm
		4 ft 5.3 in 1 ft 9.0 in

Dose Points			
#	X	Y	Z
# 1	0 cm 0.0 in	219.7227 cm 7 ft 2.5 in	0 cm 0.0 in
# 2	0 cm 0.0 in	247.6627 cm 8 ft 1.5 in	0 cm 0.0 in
# 3	0 cm 0.0 in	278.1427 cm 9 ft 1.5 in	0 cm 0.0 in
# 4	0 cm 0.0 in	308.6227 cm 10 ft 1.5 in	0 cm 0.0 in
# 5	0 cm 0.0 in	339.1027 cm 11 ft 1.5 in	0 cm 0.0 in

Shields				
<u>Shield Name</u>	<u>Dimension</u>	<u>Material</u>	<u>Density</u>	
Source	7.38e+04 in ³	V123 SLUDGE	1.02	
Shield 1	30.6 in	Air	0.00122	
Shield 2	.375 in	Iron	7.86	
Shield 3	1.25 in	Iron	7.86	
Air Gap		Air	0.00122	

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm³</u>
Ac-225	8.5036e-006	3.1463e+005	7.0299e-006	2.6011e-001
Ac-227	7.4304e-009	2.7492e+002	6.1427e-009	2.2728e-004
Ac-228	9.2959e-020	3.4395e-009	7.6849e-020	2.8434e-015
Am-241	5.2621e-003	1.9470e+008	4.3501e-003	1.6095e+002
Am-243	1.0091e-009	3.7335e+001	8.3419e-010	3.0865e-005
At-217	8.5036e-006	3.1463e+005	7.0299e-006	2.6011e-001
Ba-137m	4.6837e+000	1.7330e+011	3.8720e+000	1.4326e+005
Bi-210	1.0956e-010	4.0538e+000	9.0575e-011	3.3513e-006
Bi-211	7.2218e-009	2.6721e+002	5.9702e-009	2.2090e-004
Bi-212	4.2462e-020	1.5711e-009	3.5103e-020	1.2988e-015
Bi-213	8.5035e-006	3.1463e+005	7.0298e-006	2.6010e-001
Bi-214	1.4153e-009	5.2366e+001	1.1700e-009	4.3291e-005
Cm-243	5.0709e-004	1.8762e+007	4.1921e-004	1.5511e+001
Cm-244	4.5353e-004	1.6780e+007	3.7493e-004	1.3872e+001
Co-60	3.4923e-001	1.2922e+010	2.8871e-001	1.0682e+004
Cs-137	4.9510e+000	1.8319e+011	4.0930e+000	1.5144e+005
Eu-154	1.2567e-002	4.6500e+008	1.0389e-002	3.8441e+002
Fr-221	8.5036e-006	3.1463e+005	7.0299e-006	2.6011e-001
Fr-223	1.0254e-010	3.7939e+000	8.4768e-011	3.1364e-006
Np-237	3.2014e-005	1.1845e+006	2.6466e-005	9.7923e-001
Np-239	1.0080e-009	3.7296e+001	8.3331e-010	3.0832e-005
Pa-231	6.3436e-008	2.3471e+003	5.2443e-008	1.9404e-003

ENGINEERING DESIGN FILE

Page : 2
 DOS File : VTANK V-9 vessel 320 gal decayed 8yr 1.25 in Fe shield.ms6
 Run Date: November 16, 2004
 Run Time: 3:45:23 PM
 Duration : 00:00:02

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bg/cm^3</u>
Pa-233	3.2013e-005	1.1845e+006	2.6465e-005	9.7922e-001
Pa-234	1.3680e-007	5.0616e+003	1.1309e-007	4.1844e-003
Pa-234m	8.5500e-005	3.1635e+006	7.0683e-005	2.6153e+000
Pb-209	8.5029e-006	3.1461e+005	7.0293e-006	2.6008e-001
Pb-210	1.1036e-010	4.0834e+000	9.1236e-011	3.3757e-006
Pb-211	7.2218e-009	2.6721e+002	5.9702e-009	2.2090e-004
Pb-212	4.2465e-020	1.5712e-009	3.5106e-020	1.2989e-015
Pb-214	1.4153e-009	5.2366e+001	1.1700e-009	4.3291e-005
Po-210	9.0195e-011	3.3372e+000	7.4564e-011	2.7589e-006
Po-211	1.9715e-011	7.2947e-001	1.6299e-011	6.0305e-007
Po-212	2.7205e-020	1.0066e-009	2.2490e-020	8.3214e-016
Po-213	8.3198e-006	3.0783e+005	6.8780e-006	2.5448e-001
Po-214	1.4150e-009	5.2355e+001	1.1698e-009	4.3281e-005
Po-215	7.2220e-009	2.6721e+002	5.9704e-009	2.2090e-004
Po-216	4.2496e-020	1.5724e-009	3.5131e-020	1.2999e-015
Po-218	1.4156e-009	5.2378e+001	1.1703e-009	4.3301e-005
Pu-238	2.0090e-002	7.4331e+008	1.6608e-002	6.1449e+002
Pu-239	7.7483e-003	2.8669e+008	6.4055e-003	2.3700e+002
Pu-240	7.7439e-003	2.8652e+008	6.4019e-003	2.3687e+002
Ra-223	7.2220e-009	2.6721e+002	5.9704e-009	2.2090e-004
Ra-224	4.2496e-020	1.5724e-009	3.5131e-020	1.2999e-015
Ra-225	8.5461e-006	3.1621e+005	7.0650e-006	2.6141e-001
Ra-226	1.4210e-009	5.2576e+001	1.1747e-009	4.3464e-005
Ra-228	9.2991e-020	3.4407e-009	7.6875e-020	2.8444e-015
Rn-219	7.2220e-009	2.6721e+002	5.9704e-009	2.2090e-004
Rn-220	4.2496e-020	1.5724e-009	3.5131e-020	1.2999e-015
Rn-222	1.4156e-009	5.2378e+001	1.1703e-009	4.3301e-005
Sr-90	5.6180e+000	2.0787e+011	4.6444e+000	1.7184e+005
Th-227	7.1989e-009	2.6636e+002	5.9513e-009	2.2020e-004
Th-228	4.2755e-020	1.5819e-009	3.5346e-020	1.3078e-015
Th-229	8.6090e-006	3.1853e+005	7.1170e-006	2.6333e-001
Th-230	8.2095e-007	3.0375e+004	6.7868e-007	2.5111e-002
Th-231	3.7500e-004	1.3875e+007	3.1001e-004	1.1470e+001
Th-232	3.6209e-019	1.3397e-008	2.9934e-019	1.1076e-014
Th-234	8.5500e-005	3.1635e+006	7.0683e-005	2.6153e+000
Tl-207	7.2020e-009	2.6648e+002	5.9539e-009	2.2029e-004
Tl-208	1.5257e-020	5.6449e-010	1.2613e-020	4.6666e-016
Tl-209	1.8367e-007	6.7960e+003	1.5184e-007	5.6182e-003
U-233	1.1400e-002	4.2179e+008	9.4240e-003	3.4869e+002
U-234	1.1400e-002	4.2181e+008	9.4245e-003	3.4871e+002
U-235	3.7500e-004	1.3875e+007	3.1001e-004	1.1470e+001
U-236	1.8346e-009	6.7882e+001	1.5167e-009	5.6118e-005
U-238	8.5500e-005	3.1635e+006	7.0683e-005	2.6153e+000
Y-90	5.6194e+000	2.0792e+011	4.6456e+000	1.7189e+005

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (0,86.505,0) in

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec	MeV/cm ² /sec	mR/hr	mR/hr
0.015	2.138e+09	No Buildup 0.000e+00	With Buildup 1.645e-24	No Buildup 0.000e+00	With Buildup 1.411e-25

ENGINEERING DESIGN FILE

Page : 3
DOS File : VTANK V-9 vessel 320 gal decayed 8yr 1.25 in Fe shield.ms6
Run Date: November 16, 2004
Run Time: 3:45:23 PM
Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.02	8.777e+00	0.000e+00	1.480e-32	0.000e+00	5.127e-34
0.03	1.021e+10	6.384e-113	1.108e-22	6.326e-115	1.098e-24
0.04	2.504e+09	5.116e-50	2.431e-22	2.262e-52	1.075e-24
0.05	2.469e+07	1.418e-28	1.591e-23	3.777e-31	4.239e-26
0.06	7.085e+07	1.649e-17	1.013e-14	3.275e-20	2.011e-17
0.08	2.004e+06	2.506e-10	1.032e-07	3.966e-13	1.633e-10
0.1	2.005e+08	4.583e-05	1.050e-02	7.011e-08	1.606e-05
0.15	2.272e+06	2.346e-04	1.752e-02	3.864e-07	2.886e-05
0.2	4.300e+07	3.106e-02	1.249e+00	5.482e-05	2.205e-03
0.3	3.374e+06	1.278e-02	2.639e-01	2.424e-05	5.007e-04
0.4	3.448e+06	3.182e-02	4.446e-01	6.200e-05	8.662e-04
0.5	1.014e+06	1.747e-02	1.851e-01	3.429e-05	3.634e-04
0.6	1.560e+11	4.361e+03	3.745e+04	8.512e+00	7.310e+01
0.8	1.813e+08	1.058e+01	6.708e+01	2.012e-02	1.276e-01
1.0	1.306e+10	1.324e+03	6.766e+03	2.440e+00	1.247e+01
1.5	1.310e+10	3.445e+03	1.255e+04	5.797e+00	2.111e+01
2.0	1.054e+02	5.140e-05	1.552e-04	7.948e-08	2.399e-07
3.0	5.634e-10	6.030e-16	1.465e-15	8.180e-19	1.987e-18
TOTALS:	1.975e+11	9.141e+03	5.683e+04	1.677e+01	1.068e+02

Results - Dose Point # 2 - (0,97.505,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	0.000e+00	1.130e-24	0.000e+00	9.696e-26
0.02	8.777e+00	0.000e+00	1.017e-32	0.000e+00	3.522e-34
0.03	1.021e+10	6.313e-113	7.613e-23	6.257e-115	7.545e-25
0.04	2.504e+09	5.075e-50	1.670e-22	2.245e-52	7.388e-25
0.05	2.469e+07	1.406e-28	1.093e-23	3.745e-31	2.912e-26
0.06	7.085e+07	1.608e-17	9.839e-15	3.195e-20	1.954e-17
0.08	2.004e+06	2.226e-10	8.972e-08	3.523e-13	1.420e-10
0.1	2.005e+08	3.728e-05	8.258e-03	5.703e-08	1.263e-05
0.15	2.272e+06	1.728e-04	1.243e-02	2.845e-07	2.047e-05
0.2	4.300e+07	2.212e-02	8.597e-01	3.905e-05	1.517e-03
0.3	3.374e+06	8.885e-03	1.784e-01	1.685e-05	3.384e-04
0.4	3.448e+06	2.188e-02	2.986e-01	4.264e-05	5.819e-04
0.5	1.014e+06	1.194e-02	1.240e-01	2.343e-05	2.433e-04
0.6	1.560e+11	2.966e+03	2.503e+04	5.790e+00	4.885e+01
0.8	1.813e+08	7.152e+00	4.474e+01	1.360e-02	8.509e-02
1.0	1.306e+10	8.913e+02	4.508e+03	1.643e+00	8.309e+00
1.5	1.310e+10	2.308e+03	8.359e+03	3.883e+00	1.406e+01
2.0	1.054e+02	3.438e-05	1.034e-04	5.316e-08	1.600e-07
3.0	5.634e-10	4.033e-16	9.790e-16	5.472e-19	1.328e-18
TOTALS:	1.975e+11	6.173e+03	3.794e+04	1.133e+01	7.131e+01

Results - Dose Point # 3 - (0,109.505,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	0.000e+00	8.062e-25	0.000e+00	6.915e-26
0.02	8.777e+00	0.000e+00	7.252e-33	0.000e+00	2.512e-34
0.03	1.021e+10	6.237e-113	5.429e-23	6.181e-115	5.381e-25
0.04	2.504e+09	5.029e-50	1.191e-22	2.224e-52	5.269e-25
0.05	2.469e+07	1.374e-28	7.798e-24	3.660e-31	2.077e-26

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK V-9 vessel 320 gal decayed 8yr 1.25 in Fe shield.ms6
 Run Date: November 16, 2004
 Run Time: 3:45:23 PM
 Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
0.06	7.085e+07	1.496e-17	9.079e-15	2.972e-20	1.803e-17
0.08	2.004e+06	1.842e-10	7.282e-08	2.915e-13	1.152e-10
0.1	2.005e+08	2.873e-05	6.218e-03	4.395e-08	9.514e-06
0.15	2.272e+06	1.246e-04	8.779e-03	2.052e-07	1.446e-05
0.2	4.300e+07	1.565e-02	5.975e-01	2.762e-05	1.055e-03
0.3	3.374e+06	6.202e-03	1.229e-01	1.176e-05	2.331e-04
0.4	3.448e+06	1.519e-02	2.052e-01	2.961e-05	3.998e-04
0.5	1.014e+06	8.263e-03	8.510e-02	1.622e-05	1.670e-04
0.6	1.560e+11	2.049e+03	1.717e+04	4.000e+00	3.352e+01
0.8	1.813e+08	4.928e+00	3.070e+01	9.374e-03	5.839e-02
1.0	1.306e+10	6.134e+02	3.095e+03	1.131e+00	5.704e+00
1.5	1.310e+10	1.587e+03	5.748e+03	2.670e+00	9.672e+00
2.0	1.054e+02	2.365e-05	7.127e-05	3.657e-08	1.102e-07
3.0	5.634e-10	2.780e-16	6.768e-16	3.772e-19	9.183e-19
TOTALS:	1.975e+11	4.254e+03	2.605e+04	7.810e+00	4.896e+01

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	Results - Dose Point # 4 - (0,121.505,0) in			
		<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>		
0.015	2.138e+09	0.000e+00	6.084e-25	0.000e+00	5.218e-26
0.02	8.777e+00	0.000e+00	5.472e-33	0.000e+00	1.896e-34
0.03	1.021e+10	6.162e-113	4.097e-23	6.107e-115	4.061e-25
0.04	2.504e+09	4.961e-50	8.990e-23	2.194e-52	3.976e-25
0.05	2.469e+07	1.303e-28	5.884e-24	3.472e-31	1.568e-26
0.06	7.085e+07	1.331e-17	8.014e-15	2.644e-20	1.592e-17
0.08	2.004e+06	1.488e-10	5.808e-08	2.355e-13	9.190e-11
0.1	2.005e+08	2.215e-05	4.729e-03	3.388e-08	7.235e-06
0.15	2.272e+06	9.237e-05	6.436e-03	1.521e-07	1.060e-05
0.2	4.300e+07	1.147e-02	4.344e-01	2.025e-05	7.666e-04
0.3	3.374e+06	4.516e-03	8.898e-02	8.566e-06	1.688e-04
0.4	3.448e+06	1.103e-02	1.485e-01	2.150e-05	2.893e-04
0.5	1.014e+06	5.993e-03	6.158e-02	1.176e-05	1.209e-04
0.6	1.560e+11	1.485e+03	1.243e+04	2.899e+00	2.426e+01
0.8	1.813e+08	3.570e+00	2.223e+01	6.790e-03	4.229e-02
1.0	1.306e+10	4.443e+02	2.243e+03	8.189e-01	4.135e+00
1.5	1.310e+10	1.150e+03	4.177e+03	1.935e+00	7.028e+00
2.0	1.054e+02	1.716e-05	5.190e-05	2.654e-08	8.025e-08
3.0	5.634e-10	2.023e-16	4.945e-16	2.745e-19	6.709e-19
TOTALS:	1.975e+11	3.083e+03	1.887e+04	5.660e+00	3.547e+01

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	Results - Dose Point # 5 - (0,133.505,0) in			
		<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>		
0.015	2.138e+09	0.000e+00	4.717e-25	0.000e+00	4.046e-26
0.02	8.777e+00	0.000e+00	4.243e-33	0.000e+00	1.470e-34
0.03	1.021e+10	6.087e-113	3.176e-23	6.032e-115	3.148e-25
0.04	2.504e+09	4.836e-50	6.970e-23	2.139e-52	3.083e-25
0.05	2.469e+07	1.200e-28	4.562e-24	3.196e-31	1.215e-26
0.06	7.085e+07	1.154e-17	6.900e-15	2.292e-20	1.371e-17
0.08	2.004e+06	1.200e-10	4.645e-08	1.900e-13	7.351e-11
0.1	2.005e+08	1.732e-05	3.668e-03	2.650e-08	5.612e-06
0.15	2.272e+06	7.048e-05	4.883e-03	1.161e-07	8.041e-06

ENGINEERING DESIGN FILE

Page : 5
DOS File : VTANK V-9 vessel 320 gal decayed 8yr 1.25 in Fe shield.ms6
Run Date: November 16, 2004
Run Time: 3:45:23 PM
Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.2	4.300e+07	8.699e-03	3.280e-01	1.535e-05	5.789e-04
0.3	3.374e+06	3.410e-03	6.708e-02	6.469e-06	1.272e-04
0.4	3.448e+06	8.325e-03	1.119e-01	1.622e-05	2.181e-04
0.5	1.014e+06	4.519e-03	4.644e-02	8.871e-06	9.116e-05
0.6	1.560e+11	1.120e+03	9.379e+03	2.186e+00	1.831e+01
0.8	1.813e+08	2.692e+00	1.679e+01	5.120e-03	3.194e-02
1.0	1.306e+10	3.351e+02	1.696e+03	6.177e-01	3.126e+00
1.5	1.310e+10	8.687e+02	3.164e+03	1.462e+00	5.324e+00
2.0	1.054e+02	1.298e-05	3.939e-05	2.007e-08	6.091e-08
3.0	5.634e-10	1.534e-16	3.763e-16	2.082e-19	5.105e-19
TOTALS:	1.975e+11	2.326e+03	1.426e+04	4.270e+00	2.679e+01

ENGINEERING DESIGN FILE

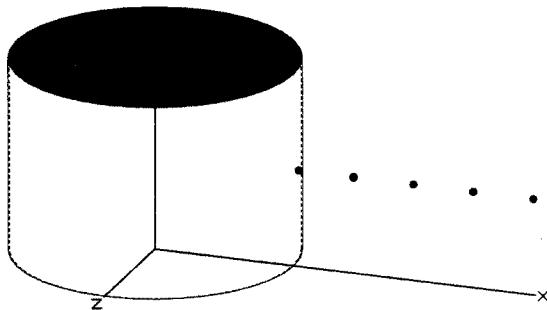
MicroShield v6.02 (6.02-00061) INEEL

Page : 1
DOS File : VTANK RX vessel 400 gal (2940 gal) decayed 8yr & 6yr of 63
Run Date: November 16, 2004
Run Time: 11:36:14 AM
Duration : 00:00:31

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: Vtank RX vessel

Description: Vtank+ARA waste Decayed 8&6yr 2940 gal (940 gal) 63 gal batc
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions

Height	98.07 cm	3 ft 2.6 in
Radius	70.104 cm	2 ft 3.6 in

Dose Points

#	X	Y	Z
# 1	73.279 cm 2 ft 4.9 in	49 cm 1 ft 7.3 in	0 cm 0.0 in
# 2	101.219 cm 3 ft 3.9 in	49 cm 1 ft 7.3 in	0 cm 0.0 in
# 3	131.699 cm 4 ft 3.9 in	49 cm 1 ft 7.3 in	0 cm 0.0 in
# 4	162.179 cm 5 ft 3.9 in	49 cm 1 ft 7.3 in	0 cm 0.0 in
# 5	192.659 cm 6 ft 3.9 in	49 cm 1 ft 7.3 in	0 cm 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	9.24e+04 in ³	V123 SLUDGE	1.02
Shield 1	.25 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input

Grouping Method : Standard Indices

Number of Groups : 25

Lower Energy Cutoff : 0.015

Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Ac-227	1.8985e-010	7.0243e+000	1.2538e-010	4.6391e-006
Ac-228	5.5560e-021	2.0557e-010	3.6693e-021	1.3577e-016
Ag-108	5.3200e-006	1.9684e+005	3.5135e-006	1.3000e-001
Ag-108m	5.7168e-005	2.1152e+006	3.7756e-005	1.3970e+000
Ag-110	3.8077e-010	1.4088e+001	2.5147e-010	9.3044e-006
Ag-110m	2.8638e-008	1.0596e+003	1.8913e-008	6.9979e-004
Am-241	5.9206e-004	2.1906e+007	3.9102e-004	1.4468e+001
Am-243	2.3168e-010	8.5720e+000	1.5301e-010	5.6613e-006
At-217	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Ba-137m	3.9149e-001	1.4485e+010	2.5855e-001	9.5665e+003
Bi-210	2.4991e-005	9.2467e+005	1.6505e-005	6.1068e-001
Bi-211	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Bi-212	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Bi-213	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Bi-214	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Ce-144	5.2127e-007	1.9287e+004	3.4427e-007	1.2738e-002
Cm-242	9.0418e-012	3.3455e-001	5.9715e-012	2.2095e-007
Cm-243	1.1691e-004	4.3257e+006	7.7212e-005	2.8568e+000
Cm-244	1.0425e-004	3.8574e+006	6.8853e-005	2.5476e+000
Co-58	5.6632e-017	2.0954e-006	3.7402e-017	1.3839e-012
Co-60	7.9907e-003	2.9566e+008	5.2773e-003	1.9526e+002
Cs-134	9.2027e-006	3.4050e+005	6.0778e-006	2.2488e-001

Page : 2
DOS File : VTANK RX vessel 400 gal (2940 gal) decayed 8yr & 6yr of 63
Run Date: November 16, 2004
Run Time: 11:36:14 AM
Duration : 00:00:31

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bg/cm^3
Cs-137	4.1402e-001	1.5319e+010	2.7343e-001	1.0117e+004
Eu-152	7.8620e-004	2.9089e+007	5.1923e-004	1.9212e+001
Eu-154	1.0619e-003	3.9289e+007	7.0128e-004	2.5947e+001
Eu-155	7.2828e-005	2.6946e+006	4.8098e-005	1.7796e+000
Fe-55	1.4694e-010	5.4369e+000	9.7046e-011	3.5907e-006
Fr-221	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Fr-223	2.6171e-012	9.6832e-002	1.7284e-012	6.3951e-008
Gd-152	1.3514e-017	5.0004e-007	8.9254e-018	3.3024e-013
H-3	6.8538e-005	2.5359e+006	4.5265e-005	1.6748e+000
I-129	3.6897e-006	1.3652e+005	2.4368e-006	9.0161e-002
Mn-54	5.2878e-008	1.9565e+003	3.4922e-008	1.2921e-003
Nb-95	6.5427e-017	2.4208e-006	4.3210e-017	1.5988e-012
Nb-95m	2.5098e-019	9.2864e-009	1.6576e-019	6.1330e-015
Ni-63	5.5989e-002	2.0716e+009	3.6977e-002	1.3681e+003
Np-237	1.8019e-006	6.6671e+004	1.1901e-006	4.4032e-002
Np-239	2.3168e-010	8.5720e+000	1.5301e-010	5.6613e-006
Pa-231	1.6196e-009	5.9925e+001	1.0696e-009	3.9576e-005
Pa-233	1.8019e-006	6.6671e+004	1.1901e-006	4.4032e-002
Pa-234	9.2456e-009	3.4209e+002	6.1061e-009	2.2593e-004
Pa-234m	5.7812e-006	2.1390e+005	3.8181e-006	1.4127e-001
Pb-209	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Pb-210	2.5098e-005	9.2864e+005	1.6576e-005	6.1330e-001
Pb-211	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Pb-212	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Pb-214	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Po-210	2.3489e-005	8.6911e+005	1.5513e-005	5.7399e-001
Po-211	5.0304e-013	1.8612e-002	3.3222e-013	1.2292e-008
Po-212	7.4437e-012	2.7542e-001	4.9161e-012	1.8189e-007
Po-213	2.1988e-007	8.1355e+003	1.4521e-007	5.3730e-003
Po-214	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Po-215	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Po-216	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Po-218	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Pr-144	5.2127e-007	1.9287e+004	3.4427e-007	1.2738e-002
Pr-144m	7.4544e-009	2.7581e+002	4.9231e-009	1.8216e-004
Pu-238	8.9453e-004	3.3098e+007	5.9078e-004	2.1859e+001
Pu-239	4.9660e-004	1.8374e+007	3.2797e-004	1.2135e+001
Pu-240	4.6335e-004	1.7144e+007	3.0601e-004	1.1323e+001
Ra-223	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Ra-224	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Ra-225	2.2631e-007	8.3736e+003	1.4947e-007	5.5302e-003
Ra-226	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Ra-228	5.5560e-021	2.0557e-010	3.6693e-021	1.3577e-016
Rh-103m	1.0383e-024	3.8415e-014	6.8570e-025	2.5371e-020
Rh-106	2.8531e-006	1.0556e+005	1.8843e-006	6.9717e-002
Rn-219	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Rn-220	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Rn-222	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Ru-103	1.0404e-024	3.8495e-014	6.8711e-025	2.5423e-020
Ru-106	2.8531e-006	1.0556e+005	1.8843e-006	6.9717e-002
Sb-125	3.7648e-005	1.3930e+006	2.4864e-005	9.1995e-001
Sr-90	7.3901e-001	2.7343e+010	4.8806e-001	1.8058e+004
Te-125m	9.2135e-006	3.4090e+005	6.0849e-006	2.2514e-001
Th-227	1.8341e-010	6.7862e+000	1.2113e-010	4.4818e-006
Th-228	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Th-229	2.2739e-007	8.4133e+003	1.5017e-007	5.5564e-003
Th-230	2.4884e-008	9.2070e+002	1.6434e-008	6.0806e-004
Th-231	9.6425e-006	3.5677e+005	6.3682e-006	2.3562e-001
Th-232	2.1666e-020	8.0165e-010	1.4309e-020	5.2943e-016
Th-234	5.7812e-006	2.1390e+005	3.8181e-006	1.4127e-001

ENGINEERING DESIGN FILE

Page : 3
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<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
TI-207	1.8341e-010	6.7862e+000	1.2113e-010	4.4818e-006
TI-208	4.1723e-012	1.5438e-001	2.7555e-012	1.0196e-007
TI-209	4.8481e-009	1.7938e+002	3.2018e-009	1.1847e-004
U-233	3.0247e-004	1.1191e+007	1.9976e-004	7.3911e+000
U-234	3.5395e-004	1.3096e+007	2.3376e-004	8.6491e+000
U-235	9.6425e-006	3.5677e+005	6.3682e-006	2.3562e-001
U-236	1.0940e-010	4.0479e+000	7.2253e-011	2.6734e-006
U-238	5.7812e-006	2.1390e+005	3.8181e-006	1.4127e-001
Y-90	7.3901e-001	2.7343e+010	4.8806e-001	1.8058e+004
Zn-65	2.9496e-008	1.0913e+003	1.9480e-008	7.2076e-004
Zr-95	2.9603e-017	1.0953e-006	1.9551e-017	7.2338e-013

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (28.85,1.93e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.857e+02	2.459e-141	2.799e-30	2.109e-142	2.401e-31
0.02	1.390e+06	1.726e-63	1.244e-26	5.977e-65	4.308e-28
0.03	8.549e+08	3.473e-19	3.526e-18	3.442e-21	3.495e-20
0.04	2.271e+08	6.436e-09	1.477e-07	2.847e-11	6.533e-10
0.05	6.602e+06	2.371e-06	7.915e-05	6.315e-09	2.109e-07
0.06	7.978e+06	2.505e-04	8.695e-03	4.975e-07	1.727e-05
0.08	2.014e+06	3.455e-03	9.115e-02	5.468e-06	1.442e-04
0.1	2.694e+07	2.594e-01	5.002e+00	3.968e-04	7.652e-03
0.15	7.754e+04	4.246e-03	4.810e-02	6.992e-06	7.921e-05
0.2	6.244e+06	7.221e-01	6.066e+00	1.274e-03	1.071e-02
0.3	9.413e+06	2.467e+00	1.481e+01	4.679e-03	2.810e-02
0.4	6.061e+06	2.673e+00	1.310e+01	5.209e-03	2.552e-02
0.5	4.963e+05	3.241e-01	1.369e+00	6.362e-04	2.688e-03
0.6	1.304e+10	1.170e+04	4.410e+04	2.284e+01	8.608e+01
0.8	2.314e+07	3.419e+01	1.089e+02	6.502e-02	2.072e-01
1.0	3.215e+08	6.997e+02	1.983e+03	1.290e+00	3.656e+00
1.5	3.185e+08	1.392e+03	3.251e+03	2.342e+00	5.469e+00
2.0	1.126e+06	7.939e+00	1.660e+01	1.228e-02	2.566e-02
3.0	1.541e-01	2.071e-06	3.772e-06	2.810e-09	5.117e-09
TOTALS:	1.486e+10	1.384e+04	4.950e+04	2.656e+01	9.551e+01

Results - Dose Point # 2 - (39.85,1.93e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.857e+02	3.890e-132	1.224e-30	3.336e-133	1.050e-31
0.02	1.390e+06	2.835e-60	5.440e-27	9.820e-62	1.884e-28
0.03	8.549e+08	6.291e-19	6.240e-18	6.235e-21	6.184e-20
0.04	2.271e+08	4.502e-09	1.011e-07	1.991e-11	4.472e-10
0.05	6.602e+06	1.479e-06	4.946e-05	3.939e-09	1.318e-07
0.06	7.978e+06	1.596e-04	5.654e-03	3.171e-07	1.123e-05
0.08	2.014e+06	2.270e-03	5.972e-02	3.592e-06	9.450e-05
0.1	2.694e+07	1.672e-01	3.074e+00	2.558e-04	4.703e-03

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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.15	7.754e+04	2.569e-03	2.622e-02	4.231e-06	4.318e-05
0.2	6.244e+06	4.214e-01	3.142e+00	7.438e-04	5.546e-03
0.3	9.413e+06	1.387e+00	7.375e+00	2.631e-03	1.399e-02
0.4	6.061e+06	1.470e+00	6.406e+00	2.864e-03	1.248e-02
0.5	4.963e+05	1.752e-01	6.620e-01	3.440e-04	1.299e-03
0.6	1.304e+10	6.240e+03	2.115e+04	1.218e+01	4.128e+01
0.8	2.314e+07	1.783e+01	5.155e+01	3.392e-02	9.805e-02
1.0	3.215e+08	3.586e+02	9.307e+02	6.610e-01	1.716e+00
1.5	3.185e+08	6.913e+02	1.502e+03	1.163e+00	2.527e+00
2.0	1.126e+06	3.866e+00	7.600e+00	5.979e-03	1.175e-02
3.0	1.541e-01	9.860e-07	1.712e-06	1.338e-09	2.323e-09
TOTALS:	1.486e+10	7.315e+03	2.366e+04	1.405e+01	4.567e+01

Results - Dose Point # 3 - (51.85,1.93e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.857e+02	2.588e-132	6.782e-31	2.220e-133	5.817e-32
0.02	1.390e+06	1.804e-60	3.013e-27	6.250e-62	1.044e-28
0.03	8.549e+08	4.970e-19	4.929e-18	4.925e-21	4.885e-20
0.04	2.271e+08	3.387e-09	7.602e-08	1.498e-11	3.362e-10
0.05	6.602e+06	1.102e-06	3.668e-05	2.935e-09	9.772e-08
0.06	7.978e+06	1.146e-04	3.977e-03	2.277e-07	7.900e-06
0.08	2.014e+06	1.493e-03	3.733e-02	2.363e-06	5.908e-05
0.1	2.694e+07	1.035e-01	1.788e+00	1.584e-04	2.735e-03
0.15	7.754e+04	1.493e-03	1.444e-02	2.459e-06	2.377e-05
0.2	6.244e+06	2.398e-01	1.707e+00	4.232e-04	3.013e-03
0.3	9.413e+06	7.764e-01	3.980e+00	1.473e-03	7.550e-03
0.4	6.061e+06	8.165e-01	3.450e+00	1.591e-03	6.723e-03
0.5	4.963e+05	9.686e-02	3.564e-01	1.901e-04	6.995e-04
0.6	1.304e+10	3.436e+03	1.138e+04	6.707e+00	2.222e+01
0.8	2.314e+07	9.769e+00	2.774e+01	1.858e-02	5.277e-02
1.0	3.215e+08	1.958e+02	5.010e+02	3.609e-01	9.235e-01
1.5	3.185e+08	3.756e+02	8.093e+02	6.319e-01	1.362e+00
2.0	1.126e+06	2.096e+00	4.100e+00	3.242e-03	6.340e-03
3.0	1.541e-01	5.342e-07	9.257e-07	7.248e-10	1.256e-09
TOTALS:	1.486e+10	4.021e+03	1.273e+04	7.725e+00	2.458e+01

Results - Dose Point # 4 - (63.85,1.93e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.857e+02	1.814e-132	4.332e-31	1.556e-133	3.716e-32
0.02	1.390e+06	1.426e-60	1.925e-27	4.940e-62	6.667e-29
0.03	8.549e+08	3.967e-19	3.934e-18	3.932e-21	3.899e-20
0.04	2.271e+08	2.659e-09	5.953e-08	1.176e-11	2.633e-10
0.05	6.602e+06	8.177e-07	2.690e-05	2.178e-09	7.167e-08
0.06	7.978e+06	8.067e-05	2.744e-03	1.602e-07	5.450e-06
0.08	2.014e+06	9.835e-04	2.399e-02	1.556e-06	3.797e-05
0.1	2.694e+07	6.626e-02	1.120e+00	1.014e-04	1.713e-03
0.15	7.754e+04	9.323e-04	8.891e-03	1.535e-06	1.464e-05
0.2	6.244e+06	1.487e-01	1.050e+00	2.624e-04	1.853e-03
0.3	9.413e+06	4.791e-01	2.449e+00	9.089e-04	4.646e-03
0.4	6.061e+06	5.032e-01	2.126e+00	9.804e-04	4.142e-03

ENGINEERING DESIGN FILE

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 Duration : 00:00:31

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.5	4.963e+05	5.966e-02	2.198e-01	1.171e-04	4.314e-04
0.6	1.304e+10	2.116e+03	7.025e+03	4.131e+00	1.371e+01
0.8	2.314e+07	6.017e+00	1.715e+01	1.144e-02	3.262e-02
1.0	3.215e+08	1.206e+02	3.101e+02	2.224e-01	5.716e-01
1.5	3.185e+08	2.318e+02	5.022e+02	3.900e-01	8.450e-01
2.0	1.126e+06	1.296e+00	2.549e+00	2.004e-03	3.942e-03
3.0	1.541e-01	3.312e-07	5.773e-07	4.494e-10	7.833e-10
TOTALS:	1.486e+10	2.477e+03	7.864e+03	4.759e+00	1.518e+01

Results - Dose Point # 5 - (75.85, 1.93e+01, 0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.857e+02	1.384e-132	3.014e-31	1.187e-133	2.586e-32
0.02	1.390e+06	1.186e-60	1.339e-27	4.108e-62	4.640e-29
0.03	8.549e+08	3.251e-19	3.223e-18	3.222e-21	3.194e-20
0.04	2.271e+08	2.079e-09	4.634e-08	9.193e-12	2.049e-10
0.05	6.602e+06	6.047e-07	1.973e-05	1.611e-09	5.255e-08
0.06	7.978e+06	5.756e-05	1.936e-03	1.143e-07	3.845e-06
0.08	2.014e+06	6.781e-04	1.638e-02	1.073e-06	2.592e-05
0.1	2.694e+07	4.508e-02	7.561e-01	6.897e-05	1.157e-03
0.15	7.754e+04	6.277e-04	5.990e-03	1.034e-06	9.863e-06
0.2	6.244e+06	9.990e-02	7.082e-01	1.763e-04	1.250e-03
0.3	9.413e+06	3.219e-01	1.655e+00	6.107e-04	3.139e-03
0.4	6.061e+06	3.382e-01	1.438e+00	6.591e-04	2.801e-03
0.5	4.963e+05	4.013e-02	1.487e-01	7.877e-05	2.919e-04
0.6	1.304e+10	1.424e+03	4.757e+03	2.780e+00	9.285e+00
0.8	2.314e+07	4.054e+00	1.163e+01	7.711e-03	2.212e-02
1.0	3.215e+08	8.136e+01	2.105e+02	1.500e-01	3.879e-01
1.5	3.185e+08	1.567e+02	3.416e+02	2.636e-01	5.747e-01
2.0	1.126e+06	8.776e-01	1.737e+00	1.357e-03	2.686e-03
3.0	1.541e-01	2.249e-07	3.943e-07	3.052e-10	5.349e-10
TOTALS:	1.486e+10	1.668e+03	5.327e+03	3.204e+00	1.028e+01

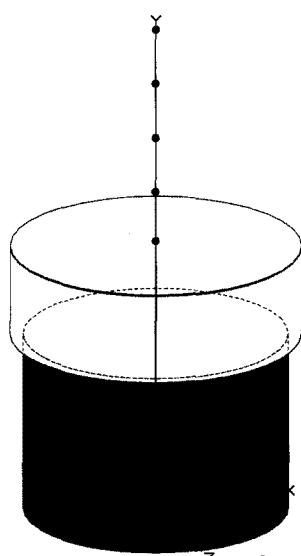
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK RX vessel 400 gal (2940 gal) decayed 8yr & 6yr of 63
 Run Date: November 16, 2004
 Run Time: 1:57:31 PM
 Duration : 00:00:02

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: Vtank RX vessel
Description: Vtank+ARA waste Decayed 8&6yr 2940 gal (940 gal) top no shld
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	98.07 cm	3 ft 2.6 in
Radius	70.104 cm	2 ft 3.6 in

Dose Points

#	X	Y	Z
# 1	0 cm	150.175 cm	0 cm
	0.0 in	4 ft 11.1 in	0.0 in
# 2	0 cm	178.115 cm	0 cm
	0.0 in	5 ft 10.1 in	0.0 in
# 3	0 cm	208.595 cm	0 cm
	0.0 in	6 ft 10.1 in	0.0 in
# 4	0 cm	239.075 cm	0 cm
	0.0 in	7 ft 10.1 in	0.0 in
# 5	0 cm	269.555 cm	0 cm
	0.0 in	8 ft 10.1 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	9.24e+04 in ³	V123 SLUDGE	1.02
Shield 1	19.264 in	Air	0.00122
Shield 2	.25 in	Iron	7.86
Air Gap		Air	0.00122

Source Input

Grouping Method : Standard Indices

Number of Groups : 25

Lower Energy Cutoff : 0.015

Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm ³
Ac-225	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Ac-227	1.8985e-010	7.0243e+000	1.2538e-010	4.6391e-006
Ac-228	5.5560e-021	2.0557e-010	3.6693e-021	1.3577e-016
Ag-108	5.3200e-006	1.9684e+005	3.5135e-006	1.3000e-001
Ag-108m	5.7168e-005	2.1152e+006	3.7756e-005	1.3970e+000
Ag-110	3.8077e-010	1.4088e+001	2.5147e-010	9.3044e-006
Ag-110m	2.8638e-008	1.0596e+003	1.8913e-008	6.9979e-004
Am-241	5.9206e-004	2.1906e+007	3.9102e-004	1.4468e+001
Am-243	2.3168e-010	8.5720e+000	1.5301e-010	5.6613e-006
At-217	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Ba-137m	3.9149e-001	1.4485e+010	2.5855e-001	9.5665e+003
Bi-210	2.4991e-005	9.2467e+005	1.6505e-005	6.1068e-001
Bi-211	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Bi-212	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Bi-213	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Bi-214	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Ce-144	5.2127e-007	1.9287e+004	3.4427e-007	1.2738e-002
Cm-242	9.0418e-012	3.3455e-001	5.9715e-012	2.2095e-007
Cm-243	1.1691e-004	4.3257e+006	7.7212e-005	2.8568e+000
Cm-244	1.0425e-004	3.8574e+006	6.8853e-005	2.5476e+000
Co-58	5.6632e-017	2.0954e-006	3.7402e-017	1.3839e-012
Co-60	7.9907e-003	2.9566e+008	5.2773e-003	1.9526e+002
Cs-134	9.2027e-006	3.4050e+005	6.0778e-006	2.2488e-001

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Duration : 00:00:02

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Cs-137	4.1402e-001	1.5319e+010	2.7343e-001	1.0117e+004
Eu-152	7.8620e-004	2.9089e+007	5.1923e-004	1.9212e+001
Eu-154	1.0619e-003	3.9289e+007	7.0128e-004	2.5947e+001
Eu-155	7.2828e-005	2.6946e+006	4.8098e-005	1.7796e+000
Fe-55	1.4694e-010	5.4369e+000	9.7046e-011	3.5907e-006
Fr-221	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Fr-223	2.6171e-012	9.6832e-002	1.7284e-012	6.3951e-008
Gd-152	1.3514e-017	5.0004e-007	8.9254e-018	3.3024e-013
H-3	6.8538e-005	2.5359e+006	4.5265e-005	1.6748e+000
I-129	3.6897e-006	1.3652e+005	2.4368e-006	9.0161e-002
Mn-54	5.2878e-008	1.9565e+003	3.4922e-008	1.2921e-003
Nb-95	6.5427e-017	2.4208e-006	4.3210e-017	1.5988e-012
Nb-95m	2.5098e-019	9.2864e-009	1.6576e-019	6.1330e-015
Ni-63	5.5989e-002	2.0716e+009	3.6977e-002	1.3681e+003
Np-237	1.8019e-006	6.6671e+004	1.1901e-006	4.4032e-002
Np-239	2.3168e-010	8.5720e+000	1.5301e-010	5.6613e-006
Pa-231	1.6196e-009	5.9925e+001	1.0696e-009	3.9576e-005
Pa-233	1.8019e-006	6.6671e+004	1.1901e-006	4.4032e-002
Pa-234	9.2456e-009	3.4209e+002	6.1061e-009	2.2593e-004
Pa-234m	5.7812e-006	2.1390e+005	3.8181e-006	1.4127e-001
Pb-209	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Pb-210	2.5098e-005	9.2864e+005	1.6576e-005	6.1330e-001
Pb-211	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Pb-212	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Pb-214	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Po-210	2.3489e-005	8.6911e+005	1.5513e-005	5.7399e-001
Po-211	5.0304e-013	1.8612e-002	3.3222e-013	1.2292e-008
Po-212	7.4437e-012	2.7542e-001	4.9161e-012	1.8189e-007
Po-213	2.1988e-007	8.1355e+003	1.4521e-007	5.3730e-003
Po-214	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Po-215	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Po-216	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Po-218	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Pr-144	5.2127e-007	1.9287e+004	3.4427e-007	1.2738e-002
Pr-144m	7.4544e-009	2.7581e+002	4.9231e-009	1.8216e-004
Pu-238	8.9453e-004	3.3098e+007	5.9078e-004	2.1859e+001
Pu-239	4.9660e-004	1.8374e+007	3.2797e-004	1.2135e+001
Pu-240	4.6335e-004	1.7144e+007	3.0601e-004	1.1323e+001
Ra-223	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Ra-224	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Ra-225	2.2631e-007	8.3736e+003	1.4947e-007	5.5302e-003
Ra-226	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Ra-228	5.5560e-021	2.0557e-010	3.6693e-021	1.3577e-016
Rh-103m	1.0383e-024	3.8415e-014	6.8570e-025	2.5371e-020
Rh-106	2.8531e-006	1.0556e+005	1.8843e-006	6.9717e-002
Rn-219	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Rn-220	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Rn-222	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Ru-103	1.0404e-024	3.8495e-014	6.8711e-025	2.5423e-020
Ru-106	2.8531e-006	1.0556e+005	1.8843e-006	6.9717e-002
Sb-125	3.7648e-005	1.3930e+006	2.4864e-005	9.1995e-001
Sr-90	7.3901e-001	2.7343e+010	4.8806e-001	1.8058e+004
Te-125m	9.2135e-006	3.4090e+005	6.0849e-006	2.2514e-001
Th-227	1.8341e-010	6.7862e+000	1.2113e-010	4.4818e-006
Th-228	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Th-229	2.2739e-007	8.4133e+003	1.5017e-007	5.5564e-003
Th-230	2.4884e-008	9.2070e+002	1.6434e-008	6.0806e-004
Th-231	9.6425e-006	3.5677e+005	6.3682e-006	2.3562e-001
Th-232	2.1666e-020	8.0165e-010	1.4309e-020	5.2943e-016
Th-234	5.7812e-006	2.1390e+005	3.8181e-006	1.4127e-001

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<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
TI-207	1.8341e-010	6.7862e+000	1.2113e-010	4.4818e-006
TI-208	4.1723e-012	1.5438e-001	2.7555e-012	1.0196e-007
TI-209	4.8481e-009	1.7938e+002	3.2018e-009	1.1847e-004
U-233	3.0247e-004	1.1191e+007	1.9976e-004	7.3911e+000
U-234	3.5395e-004	1.3096e+007	2.3376e-004	8.6491e+000
U-235	9.6425e-006	3.5677e+005	6.3682e-006	2.3562e-001
U-236	1.0940e-010	4.0479e+000	7.2253e-011	2.6734e-006
U-238	5.7812e-006	2.1390e+005	3.8181e-006	1.4127e-001
Y-90	7.3901e-001	2.7343e+010	4.8806e-001	1.8058e+004
Zn-65	2.9496e-008	1.0913e+003	1.9480e-008	7.2076e-004
Zr-95	2.9603e-017	1.0953e-006	1.9551e-017	7.2338e-013

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (0,5.91e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.803e+08	7.245e-127	2.633e-25	6.214e-128	2.258e-26
0.02	1.390e+06	3.312e-60	4.449e-61	1.147e-61	1.541e-28
0.03	8.549e+08	9.351e-19	9.273e-18	9.267e-21	9.190e-20
0.04	2.271e+08	6.483e-09	1.457e-07	2.867e-11	6.443e-10
0.05	6.602e+06	2.161e-06	7.249e-05	5.756e-09	1.931e-07
0.06	7.978e+06	2.339e-04	8.261e-03	4.647e-07	1.641e-05
0.08	2.014e+06	3.208e-03	8.125e-02	5.076e-06	1.286e-04
0.1	2.694e+07	2.245e-01	3.832e+00	3.435e-04	5.863e-03
0.15	7.754e+04	3.184e-03	2.931e-02	5.242e-06	4.827e-05
0.2	6.244e+06	5.041e-01	3.382e+00	8.897e-04	5.969e-03
0.3	9.413e+06	1.606e+00	7.725e+00	3.046e-03	1.465e-02
0.4	6.061e+06	1.671e+00	6.629e+00	3.257e-03	1.292e-02
0.5	4.963e+05	1.967e-01	6.798e-01	3.861e-04	1.334e-03
0.6	1.304e+10	6.930e+03	2.158e+04	1.353e+01	4.213e+01
0.8	2.314e+07	1.947e+01	5.209e+01	3.704e-02	9.909e-02
1.0	3.215e+08	3.864e+02	9.336e+02	7.123e-01	1.721e+00
1.5	3.185e+08	7.268e+02	1.484e+03	1.223e+00	2.497e+00
2.0	1.126e+06	3.998e+00	7.426e+00	6.183e-03	1.148e-02
3.0	1.541e-01	9.978e-07	1.648e-06	1.354e-09	2.236e-09
TOTALS:	1.504e+10	8.071e+03	2.408e+04	1.551e+01	4.650e+01

Results - Dose Point # 2 - (0,7.01e+01,0) in

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.803e+08	6.876e-127	1.655e-25	5.898e-128	1.419e-26
0.02	1.390e+06	3.231e-60	2.796e-27	1.119e-61	9.685e-29
0.03	8.549e+08	9.245e-19	9.169e-18	9.163e-21	9.087e-20
0.04	2.271e+08	6.416e-09	1.441e-07	2.837e-11	6.374e-10
0.05	6.602e+06	2.079e-06	6.900e-05	5.537e-09	1.838e-07
0.06	7.978e+06	2.104e-04	7.171e-03	4.178e-07	1.424e-05
0.08	2.014e+06	2.513e-03	5.926e-02	3.977e-06	9.379e-05
0.1	2.694e+07	1.624e-01	2.564e+00	2.484e-04	3.922e-03

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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.15	7.754e+04	2.136e-03	1.852e-02	3.518e-06	3.049e-05
0.2	6.244e+06	3.305e-01	2.111e+00	5.834e-04	3.725e-03
0.3	9.413e+06	1.035e+00	4.799e+00	1.964e-03	9.103e-03
0.4	6.061e+06	1.069e+00	4.114e+00	2.083e-03	8.016e-03
0.5	4.963e+05	1.252e-01	4.218e-01	2.457e-04	8.279e-04
0.6	1.304e+10	4.395e+03	1.339e+04	8.579e+00	2.614e+01
0.8	2.314e+07	1.229e+01	3.233e+01	2.338e-02	6.149e-02
1.0	3.215e+08	2.431e+02	5.796e+02	4.481e-01	1.068e+00
1.5	3.185e+08	4.552e+02	9.219e+02	7.659e-01	1.551e+00
2.0	1.126e+06	2.499e+00	4.617e+00	3.865e-03	7.139e-03
3.0	1.541e-01	6.230e-07	1.026e-06	8.452e-10	1.392e-09
TOTALS:	1.504e+10	5.111e+03	1.495e+04	9.826e+00	2.886e+01

Results - Dose Point # 3 - (0,8.21e+01,0) in					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.803e+08	6.496e-127	1.098e-25	5.572e-128	9.419e-27
0.02	1.390e+06	3.145e-60	1.855e-27	1.090e-61	6.427e-29
0.03	8.549e+08	9.127e-19	9.053e-18	9.045e-21	8.972e-20
0.04	2.271e+08	6.171e-09	1.380e-07	2.729e-11	6.104e-10
0.05	6.602e+06	1.829e-06	5.949e-05	4.873e-09	1.585e-07
0.06	7.978e+06	1.690e-04	5.561e-03	3.356e-07	1.104e-05
0.08	2.014e+06	1.809e-03	4.082e-02	2.863e-06	6.459e-05
0.1	2.694e+07	1.114e-01	1.691e+00	1.704e-04	2.587e-03
0.15	7.754e+04	1.409e-03	1.193e-02	2.320e-06	1.965e-05
0.2	6.244e+06	2.157e-01	1.356e+00	3.807e-04	2.393e-03
0.3	9.413e+06	6.709e-01	3.082e+00	1.273e-03	5.847e-03
0.4	6.061e+06	6.911e-01	2.645e+00	1.347e-03	5.153e-03
0.5	4.963e+05	8.082e-02	2.714e-01	1.586e-04	5.327e-04
0.6	1.304e+10	2.835e+03	8.625e+03	5.534e+00	1.683e+01
0.8	2.314e+07	7.923e+00	2.085e+01	1.507e-02	3.966e-02
1.0	3.215e+08	1.567e+02	3.742e+02	2.888e-01	6.898e-01
1.5	3.185e+08	2.936e+02	5.968e+02	4.939e-01	1.004e+00
2.0	1.126e+06	1.614e+00	2.994e+00	2.495e-03	4.630e-03
3.0	1.541e-01	4.032e-07	6.673e-07	5.471e-10	9.054e-10
TOTALS:	1.504e+10	3.297e+03	9.629e+03	6.338e+00	1.859e+01

Results - Dose Point # 4 - (0,9.41e+01,0) in					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.803e+08	6.137e-127	7.739e-26	5.264e-128	6.638e-27
0.02	1.390e+06	3.062e-60	1.308e-27	1.061e-61	4.530e-29
0.03	8.549e+08	8.945e-19	8.871e-18	8.865e-21	8.792e-20
0.04	2.271e+08	5.617e-09	1.248e-07	2.484e-11	5.518e-10
0.05	6.602e+06	1.510e-06	4.827e-05	4.022e-09	1.286e-07
0.06	7.978e+06	1.304e-04	4.196e-03	2.590e-07	8.334e-06
0.08	2.014e+06	1.308e-03	2.885e-02	2.069e-06	4.565e-05
0.1	2.694e+07	7.848e-02	1.171e+00	1.201e-04	1.792e-03
0.15	7.754e+04	9.740e-04	8.194e-03	1.604e-06	1.349e-05
0.2	6.244e+06	1.484e-01	9.309e-01	2.619e-04	1.643e-03
0.3	9.413e+06	4.605e-01	2.119e+00	8.735e-04	4.020e-03
0.4	6.061e+06	4.741e-01	1.821e+00	9.238e-04	3.548e-03

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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.5	4.963e+05	5.545e-02	1.870e-01	1.088e-04	3.671e-04
0.6	1.304e+10	1.946e+03	5.949e+03	3.798e+00	1.161e+01
0.8	2.314e+07	5.441e+00	1.440e+01	1.035e-02	2.739e-02
1.0	3.215e+08	1.077e+02	2.588e+02	1.985e-01	4.771e-01
1.5	3.185e+08	2.022e+02	4.137e+02	3.402e-01	6.960e-01
2.0	1.126e+06	1.113e+00	2.079e+00	1.722e-03	3.215e-03
3.0	1.541e-01	2.790e-07	4.644e-07	3.786e-10	6.301e-10
TOTALS:	1.504e+10	2.263e+03	6.644e+03	4.351e+00	1.283e+01

Results - Dose Point # 5 - (0,1.06e+02,0) in					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.803e+08	5.797e-127	5.772e-26	4.972e-128	4.950e-27
0.02	1.390e+06	2.982e-60	9.752e-28	1.033e-61	3.378e-29
0.03	8.549e+08	8.584e-19	8.507e-18	8.507e-21	8.431e-20
0.04	2.271e+08	4.893e-09	1.080e-07	2.164e-11	4.774e-10
0.05	6.602e+06	1.217e-06	3.845e-05	3.242e-09	1.024e-07
0.06	7.978e+06	1.005e-04	3.191e-03	1.997e-07	6.339e-06
0.08	2.014e+06	9.693e-04	2.114e-02	1.534e-06	3.345e-05
0.1	2.694e+07	5.734e-02	8.497e-01	8.773e-05	1.300e-03
0.15	7.754e+04	7.045e-04	5.927e-03	1.160e-06	9.760e-06
0.2	6.244e+06	1.071e-01	6.739e-01	1.890e-04	1.189e-03
0.3	9.413e+06	3.321e-01	1.537e+00	6.300e-04	2.915e-03
0.4	6.061e+06	3.421e-01	1.322e+00	6.666e-04	2.576e-03
0.5	4.963e+05	4.003e-02	1.359e-01	7.858e-05	2.668e-04
0.6	1.304e+10	1.405e+03	4.326e+03	2.743e+00	8.444e+00
0.8	2.314e+07	3.934e+00	1.049e+01	7.484e-03	1.995e-02
1.0	3.215e+08	7.796e+01	1.887e+02	1.437e-01	3.478e-01
1.5	3.185e+08	1.467e+02	3.023e+02	2.468e-01	5.087e-01
2.0	1.126e+06	8.096e-01	1.522e+00	1.252e-03	2.354e-03
3.0	1.541e-01	2.035e-07	3.408e-07	2.761e-10	4.623e-10
TOTALS:	1.504e+10	1.636e+03	4.834e+03	3.144e+00	9.331e+00

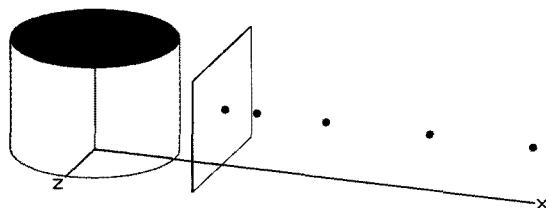
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

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File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: Vtank RX vessel
Description: Vtank+ARA waste Decayed 8&6yr 2940 gal (940 gal) 3/8" Fe shd
Geometry: 7 - Cylinder Volume - Side Shields



	Source Dimensions		
	Height	98.07 cm	3 ft 2.6 in
	Radius	70.104 cm	2 ft 3.6 in

Dose Points			
#	X	Y	Z
# 1	114.872 cm 3 ft 9.2 in	49 cm 1 ft 7.3 in	0 cm 0.0 in
# 2	142.812 cm 4 ft 8.2 in	49 cm 1 ft 7.3 in	0 cm 0.0 in
# 3	203.772 cm 6 ft 8.2 in	49 cm 1 ft 7.3 in	0 cm 0.0 in
# 4	295.212 cm 9 ft 8.2 in	49 cm 1 ft 7.3 in	0 cm 0.0 in
# 5	386.652 cm 12 ft 8.2 in	49 cm 1 ft 7.3 in	0 cm 0.0 in

Shields			
Shield Name	Dimension	Material	Density
Source	9.24e+04 in ³	V123 SLUDGE	1.02
Shield 1	.25 in	Iron	7.86
Transition	16.0 in	Air	0.00122
Shield 3	.375 in	Iron	7.86
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm ³
Ac-225	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Ac-227	1.8985e-010	7.0243e+000	1.2538e-010	4.6391e-006
Ac-228	5.5560e-021	2.0557e-010	3.6693e-021	1.3577e-016
Ag-108	5.3200e-006	1.9684e+005	3.5135e-006	1.3000e-001
Ag-108m	5.7168e-005	2.1152e+006	3.7756e-005	1.3970e+000
Ag-110	3.8077e-010	1.4088e+001	2.5147e-010	9.3044e-006
Ag-110m	2.8638e-008	1.0596e+003	1.8913e-008	6.9979e-004
Am-241	5.9206e-004	2.1906e+007	3.9102e-004	1.4468e+001
Am-243	2.3168e-010	8.5720e+000	1.5301e-010	5.6613e-006
At-217	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Ba-137m	3.9149e-001	1.4485e+010	2.5855e-001	9.5665e+003
Bi-210	2.4991e-005	9.2467e+005	1.6505e-005	6.1068e-001
Bi-211	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Bi-212	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Bi-213	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Bi-214	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Ce-144	5.2127e-007	1.9287e+004	3.4427e-007	1.2738e-002
Cm-242	9.0418e-012	3.3455e-001	5.9715e-012	2.2095e-007
Cm-243	1.1691e-004	4.3257e+006	7.7212e-005	2.8568e+000
Cm-244	1.0425e-004	3.8574e+006	6.8853e-005	2.5476e+000
Co-58	5.6632e-017	2.0954e-006	3.7402e-017	1.3839e-012
Co-60	7.9907e-003	2.9566e+008	5.2773e-003	1.9526e+002

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Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Cs-134	9.2027e-006	3.4050e+005	6.0778e-006	2.2488e-001
Cs-137	4.1402e-001	1.5319e+010	2.7343e-001	1.0117e+004
Eu-152	7.8620e-004	2.9089e+007	5.1923e-004	1.9212e+001
Eu-154	1.0619e-003	3.9289e+007	7.0128e-004	2.5947e+001
Eu-155	7.2828e-005	2.6946e+006	4.8098e-005	1.7796e+000
Fe-55	1.4694e-010	5.4369e+000	9.7046e-011	3.5907e-006
Fr-221	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Fr-223	2.6171e-012	9.6832e-002	1.7284e-012	6.3951e-008
Gd-152	1.3514e-017	5.0004e-007	8.9254e-018	3.3024e-013
H-3	6.8538e-005	2.5359e+006	4.5265e-005	1.6748e+000
I-129	3.6897e-006	1.3652e+005	2.4368e-006	9.0161e-002
Mn-54	5.2878e-008	1.9565e+003	3.4922e-008	1.2921e-003
Nb-95	6.5427e-017	2.4208e-006	4.3210e-017	1.5988e-012
Nb-95m	2.5098e-019	9.2864e-009	1.6576e-019	6.1330e-015
Ni-63	5.5989e-002	2.0716e+009	3.6977e-002	1.3681e+003
Np-237	1.8019e-006	6.6671e+004	1.1901e-006	4.4032e-002
Np-239	2.3168e-010	8.5720e+000	1.5301e-010	5.6613e-006
Pa-231	1.6196e-009	5.9925e+001	1.0696e-009	3.9576e-005
Pa-233	1.8019e-006	6.6671e+004	1.1901e-006	4.4032e-002
Pa-234	9.2456e-009	3.4209e+002	6.1061e-009	2.2593e-004
Pa-234m	5.7812e-006	2.1390e+005	3.8181e-006	1.4127e-001
Pb-209	2.2417e-007	8.2943e+003	1.4805e-007	5.4778e-003
Pb-210	2.5098e-005	9.2864e+005	1.6576e-005	6.1330e-001
Pb-211	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Pb-212	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Pb-214	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Po-210	2.3489e-005	8.6911e+005	1.5513e-005	5.7399e-001
Po-211	5.0304e-013	1.8612e-002	3.3222e-013	1.2292e-008
Po-212	7.4437e-012	2.7542e-001	4.9161e-012	1.8189e-007
Po-213	2.1988e-007	8.1355e+003	1.4521e-007	5.3730e-003
Po-214	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Po-215	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Po-216	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Po-218	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Pr-144	5.2127e-007	1.9287e+004	3.4427e-007	1.2738e-002
Pr-144m	7.4544e-009	2.7581e+002	4.9231e-009	1.8216e-004
Pu-238	8.9453e-004	3.3098e+007	5.9078e-004	2.1859e+001
Pu-239	4.9660e-004	1.8374e+007	3.2797e-004	1.2135e+001
Pu-240	4.6335e-004	1.7144e+007	3.0601e-004	1.1323e+001
Ra-223	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Ra-224	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Ra-225	2.2631e-007	8.3736e+003	1.4947e-007	5.5302e-003
Ra-226	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Ra-228	5.5560e-021	2.0557e-010	3.6693e-021	1.3577e-016
Rh-103m	1.0383e-024	3.8415e-014	6.8570e-025	2.5371e-020
Rh-106	2.8531e-006	1.0556e+005	1.8843e-006	6.9717e-002
Rn-219	1.8448e-010	6.8259e+000	1.2184e-010	4.5080e-006
Rn-220	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Rn-222	1.1369e-004	4.2067e+006	7.5087e-005	2.7782e+000
Ru-103	1.0404e-024	3.8495e-014	6.8711e-025	2.5423e-020
Ru-106	2.8531e-006	1.0556e+005	1.8843e-006	6.9717e-002
Sb-125	3.7648e-005	1.3930e+006	2.4864e-005	9.1995e-001
Sr-90	7.3901e-001	2.7343e+010	4.8806e-001	1.8058e+004
Te-125m	9.2135e-006	3.4090e+005	6.0849e-006	2.2514e-001
Th-227	1.8341e-010	6.7862e+000	1.2113e-010	4.4818e-006
Th-228	1.1584e-011	4.2860e-001	7.6503e-012	2.8306e-007
Th-229	2.2739e-007	8.4133e+003	1.5017e-007	5.5564e-003
Th-230	2.4884e-008	9.2070e+002	1.6434e-008	6.0806e-004
Th-231	9.6425e-006	3.5677e+005	6.3682e-006	2.3562e-001
Th-232	2.1666e-020	8.0165e-010	1.4309e-020	5.2943e-016

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Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bg/cm^3
Th-234	5.7812e-006	2.1390e+005	3.8181e-006	1.4127e-001
Tl-207	1.8341e-010	6.7862e+000	1.2113e-010	4.4818e-006
Tl-208	4.1723e-012	1.5438e-001	2.7555e-012	1.0196e-007
Tl-209	4.8481e-009	1.7938e+002	3.2018e-009	1.1847e-004
U-233	3.0247e-004	1.1191e+007	1.9976e-004	7.3911e+000
U-234	3.5395e-004	1.3096e+007	2.3376e-004	8.6491e+000
U-235	9.6425e-006	3.5677e+005	6.3682e-006	2.3562e-001
U-236	1.0940e-010	4.0479e+000	7.2253e-011	2.6734e-006
U-238	5.7812e-006	2.1390e+005	3.8181e-006	1.4127e-001
Y-90	7.3901e-001	2.7343e+010	4.8806e-001	1.8058e+004
Zn-65	2.9496e-008	1.0913e+003	1.9480e-008	7.2076e-004
Zr-95	2.9603e-017	1.0953e-006	1.9551e-017	7.2338e-013

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (4.52e+01,1.93e+01,0) in

Energy MeV	Activity photons/sec	Fluence Rate		Exposure Rate mR/hr	Exposure Rate mR/hr With Buildup
		No Buildup MeV/cm ² /sec	With Buildup MeV/cm ² /sec		
0.015	6.857e+02	5.241e-316	9.178e-31	4.495e-317	7.872e-32
0.02	1.390e+06	1.134e-142	4.078e-27	3.929e-144	1.413e-28
0.03	8.549e+08	4.595e-45	1.613e-23	4.554e-47	1.599e-25
0.04	2.271e+08	1.032e-20	5.571e-19	4.564e-23	2.464e-21
0.05	6.602e+06	6.790e-13	6.898e-11	1.809e-15	1.837e-13
0.06	7.978e+06	1.729e-08	1.986e-06	3.435e-11	3.945e-09
0.08	2.014e+06	2.073e-05	1.650e-03	3.280e-08	2.612e-06
0.1	2.694e+07	7.765e-03	3.853e-01	1.188e-05	5.894e-04
0.15	7.754e+04	4.239e-04	9.129e-03	6.981e-07	1.503e-05
0.2	6.244e+06	9.964e-02	1.379e+00	1.759e-04	2.434e-03
0.3	9.413e+06	4.250e-01	3.686e+00	8.061e-04	6.992e-03
0.4	6.061e+06	5.066e-01	3.353e+00	9.871e-04	6.534e-03
0.5	4.963e+05	6.512e-02	3.559e-01	1.278e-04	6.986e-04
0.6	1.304e+10	2.450e+03	1.157e+04	4.782e+00	2.259e+01
0.8	2.314e+07	7.581e+00	2.902e+01	1.442e-02	5.520e-02
1.0	3.215e+08	1.614e+02	5.335e+02	2.974e-01	9.833e-01
1.5	3.185e+08	3.406e+02	8.906e+02	5.730e-01	1.498e+00
2.0	1.126e+06	2.005e+00	4.600e+00	3.100e-03	7.113e-03
3.0	1.541e-01	5.397e-07	1.058e-06	7.322e-10	1.436e-09
TOTALS:	1.486e+10	2.963e+03	1.304e+04	5.672e+00	2.515e+01

Results - Dose Point # 2 - (5.62e+01,1.93e+01,0) in

Energy MeV	Activity photons/sec	Fluence Rate		Exposure Rate mR/hr	Exposure Rate mR/hr With Buildup
		No Buildup MeV/cm ² /sec	With Buildup MeV/cm ² /sec		
0.015	6.857e+02	4.087e-316	5.688e-31	3.505e-317	4.878e-32
0.02	1.390e+06	8.264e-143	2.527e-27	2.863e-144	8.754e-29
0.03	8.549e+08	4.046e-45	9.997e-24	4.009e-47	9.908e-26
0.04	2.271e+08	8.704e-21	4.698e-19	3.849e-23	2.078e-21
0.05	6.602e+06	5.723e-13	5.810e-11	1.524e-15	1.548e-13
0.06	7.978e+06	1.432e-08	1.634e-06	2.844e-11	3.245e-09
0.08	2.014e+06	1.604e-05	1.240e-03	2.538e-08	1.963e-06

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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.1	2.694e+07	5.639e-03	2.676e-01	8.628e-06	4.094e-04
0.15	7.754e+04	2.854e-04	5.838e-03	4.700e-07	9.613e-06
0.2	6.244e+06	6.527e-02	8.613e-01	1.152e-04	1.520e-03
0.3	9.413e+06	2.724e-01	2.272e+00	5.167e-04	4.309e-03
0.4	6.061e+06	3.214e-01	2.057e+00	6.263e-04	4.008e-03
0.5	4.963e+05	4.105e-02	2.179e-01	8.057e-05	4.276e-04
0.6	1.304e+10	1.537e+03	7.076e+03	3.000e+00	1.381e+01
0.8	2.314e+07	4.724e+00	1.771e+01	8.985e-03	3.369e-02
1.0	3.215e+08	1.001e+02	3.254e+02	1.845e-01	5.998e-01
1.5	3.185e+08	2.099e+02	5.429e+02	3.531e-01	9.135e-01
2.0	1.126e+06	1.232e+00	2.805e+00	1.905e-03	4.337e-03
3.0	1.541e-01	3.310e-07	6.461e-07	4.490e-10	8.765e-10
TOTALS:	1.486e+10	1.853e+03	7.971e+03	3.550e+00	1.537e+01

Results - Dose Point # 3 - (8.02e+01,1.93e+01,0) in					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.857e+02	2.370e-316	2.682e-31	2.033e-317	2.300e-32
0.02	1.390e+06	5.866e-143	1.192e-27	2.032e-144	4.128e-29
0.03	8.549e+08	2.955e-45	4.714e-24	2.929e-47	4.672e-26
0.04	2.271e+08	6.282e-21	3.388e-19	2.779e-23	1.498e-21
0.05	6.602e+06	3.868e-13	3.893e-11	1.031e-15	1.037e-13
0.06	7.978e+06	8.870e-09	9.915e-07	1.762e-11	1.969e-09
0.08	2.014e+06	8.667e-06	6.472e-04	1.371e-08	1.024e-06
0.1	2.694e+07	2.838e-03	1.295e-01	4.341e-06	1.982e-04
0.15	7.754e+04	1.344e-04	2.668e-03	2.214e-07	4.394e-06
0.2	6.244e+06	3.016e-02	3.895e-01	5.324e-05	6.874e-04
0.3	9.413e+06	1.243e-01	1.023e+00	2.359e-04	1.940e-03
0.4	6.061e+06	1.461e-01	9.261e-01	2.846e-04	1.804e-03
0.5	4.963e+05	1.861e-02	9.810e-02	3.652e-05	1.926e-04
0.6	1.304e+10	6.956e+02	3.188e+03	1.358e+00	6.223e+00
0.8	2.314e+07	2.135e+00	7.989e+00	4.060e-03	1.520e-02
1.0	3.215e+08	4.520e+01	1.470e+02	8.332e-02	2.709e-01
1.5	3.185e+08	9.481e+01	2.460e+02	1.595e-01	4.138e-01
2.0	1.126e+06	5.572e-01	1.274e+00	8.616e-04	1.970e-03
3.0	1.541e-01	1.502e-07	2.947e-07	2.038e-10	3.998e-10
TOTALS:	1.486e+10	8.387e+02	3.593e+03	1.606e+00	6.930e+00

Results - Dose Point # 4 - (1.16e+02,1.93e+01,0) in					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.857e+02	1.380e-316	1.252e-31	1.183e-317	1.074e-32
0.02	1.390e+06	3.986e-143	5.561e-28	1.381e-144	1.926e-29
0.03	8.549e+08	1.978e-45	2.200e-24	1.960e-47	2.180e-26
0.04	2.271e+08	3.793e-21	2.038e-19	1.677e-23	9.013e-22
0.05	6.602e+06	2.091e-13	2.085e-11	5.570e-16	5.555e-14
0.06	7.978e+06	4.452e-09	4.916e-07	8.843e-12	9.764e-10
0.08	2.014e+06	4.043e-06	2.982e-04	6.398e-09	4.718e-07
0.1	2.694e+07	1.285e-03	5.812e-02	1.966e-06	8.891e-05
0.15	7.754e+04	5.957e-05	1.181e-03	9.810e-08	1.945e-06
0.2	6.244e+06	1.330e-02	1.722e-01	2.348e-05	3.039e-04
0.3	9.413e+06	5.474e-02	4.526e-01	1.038e-04	8.585e-04

ENGINEERING DESIGN FILE

Page : 5
DOS File : VTANK RX vessel 400 gal (2940 gal) decayed 8yr & 6yr of 63
Run Date : November 16, 2004
Run Time: 2:03:59 PM
Duration : 00:00:32

Energy MeV	Activity photons/sec	Fluence Rate		Exposure Rate	
		MeV/cm ² /sec No Buildup	MeV/cm ² /sec With Buildup	mR/hr No Buildup	mR/hr With Buildup
0.4	6.061e+06	6.431e-02	4.103e-01	1.253e-04	7.995e-04
0.5	4.963e+05	8.198e-03	4.352e-02	1.609e-05	8.543e-05
0.6	1.304e+10	3.067e+02	1.416e+03	5.987e-01	2.764e+00
0.8	2.314e+07	9.427e-01	3.557e+00	1.793e-03	6.766e-03
1.0	3.215e+08	1.999e+01	6.556e+01	3.685e-02	1.209e-01
1.5	3.185e+08	4.208e+01	1.102e+02	7.080e-02	1.854e-01
2.0	1.126e+06	2.481e-01	5.725e-01	3.837e-04	8.853e-04
3.0	1.541e-01	6.722e-08	1.330e-07	9.120e-11	1.805e-10
TOTALS:	1.486e+10	3.701e+02	1.597e+03	7.088e-01	3.080e+00

Results - Dose Point # 5 - (1.52e+02,1.93e+01,0) in

Energy MeV	Activity photons/sec	Fluence Rate		Exposure Rate	
		MeV/cm ² /sec No Buildup	MeV/cm ² /sec With Buildup	mR/hr No Buildup	mR/hr With Buildup
0.015	6.857e+02	9.034e-317	7.238e-32	7.748e-318	6.209e-33
0.02	1.390e+06	2.854e-143	3.216e-28	9.887e-145	1.114e-29
0.03	8.549e+08	1.340e-45	1.272e-24	1.328e-47	1.261e-26
0.04	2.271e+08	2.349e-21	1.260e-19	1.039e-23	5.572e-22
0.05	6.602e+06	1.231e-13	1.224e-11	3.279e-16	3.260e-14
0.06	7.978e+06	2.552e-09	2.810e-07	5.069e-12	5.582e-10
0.08	2.014e+06	2.265e-06	1.669e-04	3.585e-09	2.642e-07
0.1	2.694e+07	7.143e-04	3.238e-02	1.093e-06	4.954e-05
0.15	7.754e+04	3.298e-05	6.575e-04	5.430e-08	1.083e-06
0.2	6.244e+06	7.361e-03	9.592e-02	1.299e-05	1.693e-04
0.3	9.413e+06	3.032e-02	2.527e-01	5.751e-05	4.793e-04
0.4	6.061e+06	3.566e-02	2.294e-01	6.949e-05	4.470e-04
0.5	4.963e+05	4.551e-03	2.436e-02	8.933e-06	4.782e-05
0.6	1.304e+10	1.705e+02	7.936e+02	3.327e-01	1.549e+00
0.8	2.314e+07	5.249e-01	1.997e+00	9.984e-04	3.798e-03
1.0	3.215e+08	1.115e+01	3.686e+01	2.055e-02	6.794e-02
1.5	3.185e+08	2.355e+01	6.212e+01	3.962e-02	1.045e-01
2.0	1.126e+06	1.392e-01	3.234e-01	2.152e-04	5.002e-04
3.0	1.541e-01	3.785e-08	7.537e-08	5.135e-11	1.023e-10
TOTALS:	1.486e+10	2.059e+02	8.956e+02	3.943e-01	1.727e+00